APPENDIX 9

PRELIMINARY GEOTECHNICAL INVESTIGATION

THURBER ENGINEERING LTD.

FINAL
PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT
CLASS EA STUDY FOR COLUMBIA WAY
BETWEEN HIGHWAY 50 AND CALEDON-KING TOWNLINE SOUTH
TOWN OF CALEDON, ONTARIO

Report

to

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Date: April 21, 2021
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APPENDICES

1. INTRODUCTION

This report presents the factual findings obtained from a preliminary geotechnical and pavement investigation conducted in support of the Municipal Class Environmental Assessment (EA) Study for Columbia Way from Highway 50 to Caledon-King Townline in the Town of Caledon, Ontario.

Columbia Way is presently a two-lane collector roadway built to a rural cross-section. Current plans call for the urbanization of Columbia Way from Highway 50 to 0.5 km east of Mount Hope Road, and improvements to the rural setting for the remainder of the roadway to Caledon-King Townline in the Town of Caledon, Ontario. The total length of the study corridor is approximately 2.8 km.

The purpose of the geotechnical investigation was to explore the subsurface conditions within the project limits and based on the data obtained, to provide borehole logs, borehole location plans, a written description of the subsurface conditions, and preliminary geotechnical comments and recommendations regarding pavement reconstruction and/or rehabilitation, bridge and culvert foundations, excavation and dewatering and slope stability.

A limited analytical testing program was completed concurrently on selected soil samples to evaluate the environmental quality and provide preliminary management options for excess excavated soils that may be generated during the proposed construction works. Additional sample collection and analyses will be required to meet the requirements of Ontario Regulation (O.Reg.) 406/19, On-Site and Excess Soil Management.

A Contamination Overview Study (COS) was completed concurrently for this project. The results of COS were reported under a separate cover and should be read in conjunction with this report.

The scope of work for this assignment did not include a hydrogeological site assessment to evaluate construction dewatering requirements or address Ontario Ministry of the Environment, Conservation and Parks (MECP) EASR submission or PTTW application.

Thurber Engineering Ltd. (Thurber) carried out the investigation as a sub-consultant to R.V. Anderson Associates Limited who are conducting the EA Study for the Town of Caledon.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. BACKGROUND INFORMATION

2.1 Site Description

The study area extends along Columbia Way from Highway 50 to Caledon-King Townline in the Town of Caledon. The total length of the study corridor is approximately 2.8 km.

Columbia Way is an east-west collector road with a posted speed limit of 60 km/h. The roadway presently has a two-lane rural cross section with gravel shoulders. The study corridor generally consists of agricultural land to the north and residential subdivisions to the south of Columbia Way. The eastern 500 m consists of rural residential and wooded areas.

Cold Creek, a tributary of the Humber River, crosses under the road approximately 0.5 km west of Caledon-King Townline, and a seasonal tributary crosses in a culvert approximately 0.9 km east of Highway 50. Steep slopes are present locally within the Cold Creek section, notably an approximate 10 to 12 m high embankment exhibiting downslope movement of the guiderail approximately 0.7 km east of Mount Hope Road, and an eroding cut slope in a section without ditching immediately west of Caledon-King Townline. Typical photographs from the corridor are provided in Appendix A.

2.2 Existing Pavement Conditions

A visual examination of the roadway surface was carried out in August 2020 to obtain a general overview of the existing pavement conditions. It is noted that the pavement was recently resurfaced on this roadway and in that regard, the existing roadway pavement is in excellent condition and did not exhibit any pavement distress manifestations at the time of the review.

Representative photographs of the existing pavement are provided in Appendix A.

2.3 Geology

Based on the information in *The Physiography of Southern Ontario*[1] by Chapman and Putnam (1984), the site is located within the South Slope physiographic region. The South Slope is characterized by low-lying, fine-grained, undulating ground moraine and knolls.

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[1] Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Ontar]io Geological Survey Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.

Based on *Surficial Geology of Southern Ontario*[2], the surficial material of the South Slope is composed of clay and silt till where the materials may have been derived from a glaciolacustrine environment or from the shale bedrock. Ice contact stratified deposits of sand and gravel with minor silt, clay and till are located on the northeast corner of the project limits. Pockets of modern alluvial deposits comprised of clay, silt, sand, gravel and enfolded organic remains are noted within the vicinity of the study area.

According to *Paleozoic Geology of Southern Ontario*[3], the site's bedrock is comprised of the Georgian Bay Formation. The unit is composed of shale and limestone. The bedrock depth is variable due to the undulating topography, however, is expected to be approximately 50 to 85 meters.

3. INVESTIGATION PROCEDURES

3.1 Field Investigation

The field investigation for this project was carried out between September 1 to 3, 2020 and comprised a total of nine boreholes (Boreholes 20-01 to 20-09) advanced to depths ranging from 3.7 to 15.5 m. Borehole details are provided in Table 3.1 and in the Record of Borehole sheets included in Appendix B. The approximate locations of the boreholes are shown on the Borehole Location Plans, Drawings 27855-1 to 27855-2, provided in Appendix C.

Table 3.1 – Borehole Details

Facility	Borehole No.	Ground Elevation (m)	Borehole Termination Depth (m)	Borehole Termination Elevation (m)
Tributary Culvert	20-03	258.0	11.3	246.7
Embankment Slope	20-07	242.8	15.5	227.4
Cold Creek Bridge	20-08	228.1	12.6	215.5
Cut Slope	20-09	247.9	5.0	242.9
Pavement Structure, Municipal Services	20-01, 20-02, 20-04, 20-05, 20-06	257.1 to 264.5	3.7	253.4 to 260.8

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[2] Ontario Geological Survey, 2010: Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV

[3] Armstrong, D.K. and Dodge, J.E.P., 2007: Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219.

The borehole locations were established in the field by Thurber using a portable GPS receiver and verified relative to existing site features. The ground surface elevations at the borehole locations were determined using a Trimble R10 GNSS receiver.

All borehole locations were cleared of utilities prior to commencement of drilling. The boreholes were repositioned as necessary in consideration of surface features, underground utilities, and overhead wires.

The boreholes were advanced using solid stem augers powered by a truck mounted CME-55 drill rig supplied and operated by DBW Drilling Limited. Soil samples were obtained at selected intervals using a 50 mm outside diameter split-spoon sampler driven in conjunction with the Standard Penetration Test (SPT). The field investigation was carried out under the full-time supervision of Thurber technical staff. All boreholes were logged in the field. Soil samples were identified, placed in labelled containers and transported back to Thurber's laboratory in Oakville for further examination and testing.

Groundwater conditions were observed in the open boreholes throughout the drilling operations. Monitoring wells were installed in Boreholes 20-03, 20-07, 20-08 and 20-09 to permit monitoring of the groundwater levels at the site. The monitoring wells consisted of 50 mm diameter PVC pipe with a slotted screen sealed at a selected depth within the borehole. The installation details are summarized in Table 3.2 below.

Table 3.2 – Monitoring Well Details

Borehole/ Monitoring Well (BH/MW) No.	Ground Elevation (m)	Monitoring Well Tip		Slotted Screen Length (m)	Mid-Screen Depth (m)	Mid-Screen Elev. (m)
		Depth (m)	Elevation (m)			
20-03	258.0	10.6	247.4	3.0	9.1	248.9
20-07	242.8	15.2	227.6	3.0	13.7	229.1
20-08	228.1	8.5	219.6	3.0	7.0	221.1
20-09	247.9	4.3	243.6	1.5	3.6	244.3

The boreholes in which no monitoring wells were installed were backfilled in general accordance with Ontario Regulation 903.

3.2 Laboratory Testing

3.2.1 Geotechnical

Geotechnical laboratory testing was carried out at Thurber's laboratory. All recovered soil samples were subjected to visual identification and to natural moisture content determination. Selected samples were also subjected to grain size distribution analysis (hydrometer and/or sieve) and Atterberg Limits testing, where appropriate. Laboratory testing results are summarized on the Record of Borehole sheets included in Appendix B and are presented on the figures included in Appendix D.

3.2.2 Geoenvironmental

For preliminary evaluation of the environmental quality of the on-site soils, representative samples recovered from select boreholes were submitted to SGS for analysis of one or more of metals and inorganic parameters and petroleum hydrocarbons (PHC) Fractions F1 to F4, including benzene, ethylbenzene, toluene and xylenes (BTEX) in accordance with O. Reg. 153/04.

4. DESCRIPTION OF SUBSURFACE CONDITIONS

A generalized description of the subsurface conditions encountered in the boreholes is given in the following sections. Detailed descriptions of the soil conditions at the specific locations drilled are presented on the Record of Borehole sheets in Appendix B and take precedence over the generalized description. It should be recognized and expected that soil conditions will vary between and beyond borehole locations.

The subsurface stratigraphy encountered in the boreholes generally comprises a surficial pavement structure overlying deposits of fill, localized alluvial clay deposits, underlain by native deposits of silt, clay, silty clay till, and sand and silt. Further description of the individual strata are presented below.

4.1 Pavement Structure

A pavement structure was encountered at the ground surface of the boreholes and typically consisted of 35 to 60 mm of asphalt overlying a sand and gravel granular base. The granular materials extended to depths ranging from 570 to 725 mm, locally 1350 mm in Borehole 20-08.

The results of grain size analyses conducted on three samples of the granular material are presented on Figure D1 of Appendix D. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	33 to 43
Sand	43 to 61
Silt + Clay	6 to 14

None of the samples tested meet the OPSS Granular A gradation specifications. The samples tested from Boreholes 20-03 and 20-07 met the Granular B Type I gradation specifications. The results may be impacted by the effects of compaction, auger sampling procedures, infiltration of fines with road runoff, or deterioration of the granular material over time.

4.2 Fill

Fill was contacted below the pavement structure in Boreholes 20-03, 20-07 and 20-08.

In Boreholes 20-03 and 20-07, the fill layer consisted of silty clay, was 3.3 to 3.4 m thick, and was penetrated at depths of 4.1 m (Elev. 253.8 and 238.7). SPT ‘N’ values of 7 to 15 blows per 0.3 m of penetration were recorded in the clay fill layer, indicating a firm to stiff condition. Moisture contents of 13 to 27% were measured. The clay fill contained occasional organic inclusions.

In Borehole 20-08, the fill comprised dark grey silty clay over black silty sand. The silty clay layer was encountered below the pavement structure at a depth of 1.4 m (Elev. 226.7) and was penetrated at 2.6 m (Elev. 225.5). SPT ‘N’ values of 7 and 11 blows per 0.3 m of penetration were recorded, indicating a firm to stiff consistency. Silty sand fill was contacted below the clay fill at 2.6 m (Elev. 225.5) and was penetrated at 4.1 m (Elev. 224.0). An SPT ‘N’ value of 2 blows per 0.3 m of penetration was recorded, indicating a very loose condition. The sand fill contained occasional organic inclusions. Measured moisture contents were 16 to 18%.

4.3 Alluvial Clay

Locally, in Borehole 20-08, a 3.1 m thick layer of alluvial silty clay was contacted below the fill at a depth of 4.1 m (Elev. 224.0) and was penetrated at a depth of 7.2 m (Elev. 221.0). SPT ‘N’ values of 6 blows per 0.3 m of penetration were recorded in the alluvial clay layer, indicating a firm consistency. Occasional organic inclusions were noted in this stratum. Moisture contents of 18% and 23% were measured.

4.4 Silty Clay

A 0.7 m thick layer of silty clay was contacted below the pavement structure in Boreholes 20-04 and 20-05 at 0.8 m depth (Elev. 262.1 and 261.6), and was penetrated at 1.5 m (Elev. 261.4 and 260.9). In Borehole 20-03, the clay was encountered below the clay fill at a depth of 4.1 m (Elev. 253.8) and was contacted to the termination depth of 11.3 m (Elev. 246.7). SPT 'N' values of 11 to 35 blows per 0.3 m of penetration were recorded in the silty clay in Boreholes 20-03 to 20-05, indicating a consistency of stiff to hard. Moisture contents of 17 to 21% were measured, locally 36% in Borehole 20-04.

In Borehole 20-09, a 3.5 m thick layer of silty clay was encountered between 0.6 and 4.1 m depth (Elev. 247.3 and 243.8). SPT 'N' values recorded in the silty clay were 84 to 98 blows per 175 mm of penetration, indicating a hard consistency. Moisture contents of 13 to 16% were measured.

The results of grain size distribution analyses carried out on selected samples of the silty clay are shown on Figure D2 in Appendix D. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	6 to 11
Silt	46 to 66
Clay	28 to 43

Atterberg limits testing carried out on two samples of the silty clay measured plastic limits, liquid limits and plasticity indices of 15 and 21, 26 and 43, and 11 and 22, respectively. These results, which are plotted on Figure D5 in Appendix D, indicate that the samples tested consist of low to intermediate plastic silty clay (CL to CI).

4.5 Silty Clay Till

A silty clay till deposit was encountered below the pavement structure in Boreholes 20-01, 20-02, and 20-06 and below the clay at 1.5 m (Elev. 261.4 and 260.9) in Boreholes 20-04 and 20-05, respectively. Boreholes 20-02 and 20-04 to 20-06 were terminated in the till at depths of 3.7 m (Elev. 253.4 to 260.8). The clay till was penetrated at a depth of 3.0 m (Elev. 259.7) in Borehole 20-01. SPT 'N' values ranging from 8 to 50 blows per 0.3 m of penetration were recorded in the clay till deposits, indicating a stiff to hard consistency. Measured moisture contents ranged from 15 to 25%.

Till soils frequently contain cobbles and boulders, and these should be anticipated in any construction operations extending into this deposit.

4.6 Silt

A deposit of silt was encountered below the fill, clay and clay till at depths of 3.0 to 4.1 m (Elev. 238.7 to 259.7) in Boreholes 20-01, 20-07 and 20-09. The silt layer was contacted to the termination depths of 3.7 and 5.0 m (Elev. 259.0 and 242.9) in Boreholes 20-01 and 20-09, respectively. In Borehole 20-07, the silt was contacted to the termination depth of 15.5 m (Elev. 227.4) and contained a layer of sand between 8.7 and 10.0 m depth (Elev. 234.1 and 232.8). The composition of the silt varied from trace sand to sandy and trace clay to clayey with occasional silty clay partings.

SPT ‘N’ values of 12 to 81 blows per 0.3 m of penetration and up to 50 blows for 25 mm of penetration were recorded, indicating a compact to very dense condition, typically very dense. Moisture contents of 14 to 24% were measured.

The results of grain size analyses conducted on samples of the silt are presented on Figure D4 of Appendix D. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	1 to 29
Silt	59 to 96
Clay	3 to 11

Atterberg limits testing carried out on two samples of the silt measured plastic limits, liquid limits and plasticity indices of 15 and 19, 22 and 20 and 7 and 1, respectively. These results, which are plotted on Figure D6 in Appendix D, indicate that the samples tested consists of clayey silt (CL-ML) and silt (ML).

4.7 Sand

A sand layer was contacted within the silt deposit in Borehole 20-07 and below the alluvial clay in Borehole 20-08 at depths of 8.7 and 7.2 m (Elev. 234.1 and 221.0), respectively. The sand layer was penetrated at 10.0 m depth (Elev. 232.8) in Borehole 20-07; Borehole 20-08 was terminated in the sand at 12.6 m (Elev. 215.5). SPT ‘N’ values ranging from 28 to 43 blows per 0.3 m of penetration and up to 89 blows for 225 mm of penetration were recorded in the sand deposits, indicating a relative density of compact to very dense. Measured moisture contents ranged from 5 to 21%.

The results of grain size analyses conducted on samples of the sand are presented on Figure D3 of Appendix D. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	75 to 91
Silt + Clay	9 to 25

4.8 Groundwater Levels

During drilling, wet conditions were noted near 15.4 m depth in the sandy silt layer in Borehole 20-07. Upon completion of augering, free water and cave were observed at a depth of 2.6 m (Elev. 254.4) in Borehole 20-06; the remaining boreholes were open and dry.

The groundwater depths and elevations measured in the monitoring wells installed in the boreholes are summarized in Table 5.1.

Table 5.1 – Summary of Groundwater Level Observations

BH/MW No.	Ground Elev. (m)	Mid-Screen Depth (m)	Mid-Screen Elev. (m)	Ground Water Elevation (metres below ground surface)	
				Sept. 4, 2020	Oct. 2, 2020
20-03	258.0	9.1	248.9	Dry	252.7 (5.3)
20-07	242.8	13.7	229.1	230.7 (12.1)	230.5 (12.3)
20-08	228.1	7.0	221.1	225.9 (2.2)	226.2 (2.0)
20-09	247.9	3.6	244.3	Dry	253.7 (4.2)

In general, the water level in Borehole 20-08 near Cold Creek is expected to be governed by the prevailing water level in the creek. A water level of 4.2 m (Elev. 223.9) was recorded in Cold Creek at the Columbia Way bridge at the time of the drilling investigation.

The above groundwater level measurements are short-term observations and seasonal fluctuations of the creek and groundwater levels are to be expected. Further, groundwater levels may be higher after prolonged periods of precipitation.

5. ANALYTICAL LABORATORY TESTING RESULTS

Based on the conditions encountered during the investigation, it is anticipated that the soils excavated during potential roadway reconstruction works will primarily comprise existing fill materials, native silty clay and silty clay till. In general, no visual and olfactory indications of impact were observed in the soil samples recovered during the geotechnical field investigation program.

Five soil samples obtained from the boreholes were selected for analytical laboratory testing. The sample locations and material types that were selected for analysis are summarized in Table 5.2.

Table 5.2 – Soil Samples Selected for Analytical Testing

Borehole	Sample ID	Depth (m)	Material	Analysis
20-01	20-01 SS3	1.5 – 2.1	Clay Till	Metals & Inorganics PHCs F1 to F4, BTEX
20-03	20-03 SS5	2.3 – 2.9	Clay Fill	Metals & Inorganics PHCs F1 to F4, BTEX
20-05	20-05 SS5	2.3 – 2.9	Clay Till	Metals & Inorganics
20-08	20-08 SS7	6.1 – 6.7	Clay (Alluvial)	Metals & Inorganics PHCs F1 to F4, BTEX
20-09	20-09 SS5	3.0 – 3.6	Clay	Metals & Inorganics

For preliminary characterization of the on-site soils, the analytical data were compared to the MECP Table 2 “Full Depth Generic Site Condition Standards in a Potable Groundwater Condition” for Residential/Parkland/Institutional (RPI) Property Uses, coarse textured soils (MECP Table 2 RPI Standards) to assess the suitability of the on-site reuse of excavated soils within the subject site as part of the proposed construction works. Considering an existing water body (i.e. creek) that is proximal to the project limits, the analytical data was also compared to the MECP Table 8 “Full Depth Generic Site Condition Standards in a Potable Groundwater Condition” for Residential/Parkland/Institutional/Industrial/Commercial/Community (RPI/ICC) Property Uses within 30 m of a water body, coarse textured soils (MECP Table 8 Standards).

On December 4, 2019, Ministry of Environment, Conservation and Parks (MECP) filed Ontario Regulation (O. Reg.) 406/19 “On-Site and Excess Soil Management” that is to be phased in over a period extending from January 1, 2021 to January 1, 2026 where the Rules for Soil Management and Excess Soil Quality Standards under this regulation are to be adopted on January 1, 2021. In this regard, the analytical data was also compared to Table 1 RPI/ICC Property Uses and Table 2.1 RPI Property Uses of the Excess Soil Quality Standards (ESQS) for Residential/Parkland/Institutional and/or Industrial/Commercial/Community Property Uses, coarse textured soils provided under MECP’s Rules for Soil Management and O. Reg. 406/19 for comparison purposes only at this time.

The results of the analytical laboratory testing indicate that the concentrations of the tested parameters met MECP Table 2 and Table 8 Standards with the exception of electrical conductivity (EC).

Comparison to the Table 1 RPI/ICC and Table 2.1 RPA ESQS indicate the concentrations of the tested parameters met the Standards with the exceptions of EC and sodium adsorption ratio (SAR).

Laboratory Certificates of Analysis are included in Appendix E. The measured concentrations and corresponding Standards are shown on the certificates of analysis.

6. ENGINEERING DISCUSSION AND RECOMMENDATIONS

This section of the report provides preliminary geotechnical recommendations for design and construction of the roadway improvements and structure foundations. The recommendations are based on the subsurface soil and groundwater conditions encountered during the preliminary investigation. The soil conditions may vary between and beyond the borehole locations. Additional investigation will be required during the detailed design stage to supplement the subsurface information and confirm the preliminary recommendations.

6.1 Pavement Design and Construction

6.1.1 Design Analysis

Columbia Way is an east-west collector road with a posted speed limit of 60 km/h. The roadway presently has a two-lane rural cross section with gravel shoulders. Current plans call for the urbanization of Columbia Way from Highway 50 to 0.5 km east of Mount Hope Road, and improvements to the rural setting for the remainder of the roadway to Caledon-King Townline.

For the purposes of pavement design analysis, the roadway was divided into the urban and rural sections for separate assessment. The existing and projected peak hour (AM) traffic volumes within these sections, provided by RVA, are presented in Table 6.1. The section east of Kingsview Drive was selected as the most heavily travelled section in the urban area.

Table 6.1 – Columbia Way Traffic Information

Section	**AM Peak Hour Volume**			**Average Truck Volume**
	Existing (2022)	**Future (2032) without Background Development**	**Future (2032) with Background Development**	
Urban	837	1021	1070	3%
Rural	377	460	509	3%

The above volumes reflect approximate growth rates of 2% without and 2.5% to 3% with background development, respectively. To calculate traffic volumes over a 20-year design period, it has been assumed that traffic volumes will grow at a rate of 2.5% to 3% for the initial 10 years and 2% beyond.

The traffic data was used to determine the pavement damage caused by the anticipated traffic volumes over the design life of the pavement. Using axle load equivalency factors, different axle loads and axle groups are converted to a standard axle load known as an Equivalent Single Axle Loads (ESALs). The Design ESALs calculation was completed in accordance with the MTO *Procedures for Estimating Traffic Loads for Pavement Designs.* Assuming an average truck factor of 2.2, the number of ESALs during a 20-year design period was computed to be 2.7 million in the urban section (Regional Road 50 to Forest Gate Avenue) and 1.2 million in the rural section (Forest Gate Avenue to Caledon-King Townline)

The pavement design analysis was carried out using the methodology outlined in the 1993 AASHTO "*Guide for the Design of Pavement Structures*", as modified by the Ministry's "*Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions*", and the MTO "*Pavement Design and Rehabilitation Manual*". The AASHTO procedure determines a required Structural Number that characterizes the structural capacity of the pavement layers for a given set of inputs.

The following design inputs were used in the AASHTO design analysis.

- Design Period = 20 years
- Initial serviceability, (Pi) = 4.5 urban, 4.4 rural
- Terminal serviceability (Pt) = 2.5 urban, 2.2 rural
- Reliability level (R) = 90 percent
- Overall standard of deviation (So) = 0.44
- Mean soil resilient modulus (MR) = 30 MPa

The subgrade for the pavement structure is expected to consist primarily of firm to stiff silty clay fill, native firm to stiff silty clay, or stiff to hard silty clay till.

Based on the design input parameters and calculated ESALs, design structural numbers (SN_{Des}) of 119 and 104 mm are required for the west and east sections, respectively. The recommended pavement design thickness, based on the structural requirements, traffic projections, and subgrade conditions, is presented below.

6.1.2 Recommended Pavement Design

Columbia way was recently resurfaced. Based on the borehole data, it appears that the resurfacing program involved pulverizing the existing asphalt layer and placing a 35 to 60 mm thick asphalt overlay. The existing granular thickness typically ranged from 570 to 725 mm. It is presumed that resurfacing was completed as a holding strategy until reconstruction could be carried out. Images of the roadway prior to resurfacing (Google Street View) indicates that the pavement was previously in fair to poor condition with extensive cracking, rutting, distortion and edge breaks.

Considering the condition of the pavement prior to resurfacing and the plan to urbanize the majority of the roadway, complete reconstruction of the pavement structure is recommended. Based on the borehole data, the anticipated traffic volumes, and assuming adequate subgrade drainage, the following preliminary pavement design is recommended for complete reconstruction of Columbia Way:

Component	Urban Section	Rural section
HL1	50 mm	50 mm
HL8	90 mm	70 mm
OPSS Granular A Base	150 mm	150 mm
OPSS Granular B Type II Subbase	450 mm	400 mm

The pavement design thicknesses should be reviewed during detailed design.

Consideration could be given to the use of an HL3 surface course in the rural section subject to continuity with the urban pavement. If full reconstruction is not planned in the rural section, an overlay thickness comprising two 40 mm lifts of HL3 should be provided over the existing resurfaced pavement.

The minimum PGAC grade of virgin asphalt cement should be PG 58-28, increased to PG 64-28 in the surface and top binder course if Columbia Way will be a bus route. Consideration should be given to further upgrading of the PGAC grade to PG 70-28 if rutting has been experienced in other sections of this roadway due to truck traffic. Aggregates for the asphalt mixes should be in accordance with OPSS.MUNI 1003.

Should the Town consider using Superpave asphalt mixes for this project, the recommended HL1 material should be substituted with a Superpave 12.5 FC1 asphalt mix, the HL3 with SP 12.5, and the HL8 asphalt material with SP 19.0. As the 20-year design ESALs was estimated to be 2.7 to 1.2 million, a Traffic Category B designation should be used in preparing all Superpave asphalt mix designs.

All new granular subbase material should consist of OPSS Granular B Type II, while the granular base material should consist of OPSS Granular A. All new granular material should meet the requirements of OPSS.MUNI 1010, and be compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) within 2 percent of Optimum Moisture Content (OMC). All granular material should be compacted in accordance with the requirements of OPSS.MUNI 501, and should be carried the entire width of the roadway platform to maintain appropriate drainage.

6.1.3 Pavement Subgrade Preparation

Pavement subgrade preparation should include removal of the existing pavement structure and all surficial vegetation, topsoil, organic or compressible material. Grading to the new top of subgrade should match or exceed the thickness of the existing pavement to maintain lateral drainage at the top of subgrade. The exposed subgrade should be compacted and proof-rolled with a heavy roller and examined to identify areas of unstable subgrade. Any soft/wet areas identified shall be subexcavated and replaced with approved material within 2% of Optimum Moisture Content (OMC), and compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD).

Bulk fill used to raise the road grade should be constructed as engineered fill, consisting of approved inorganic material, placed in maximum 200 mm thick lifts, within 2% of optimum moisture content, and compacted to at least 98% of SPMDD. Standard side slopes of 2H:1V or flatter should be suitable for embankment construction. Exposed embankment surfaces should be provided with a vegetation cover or otherwise protected against erosion in accordance with OPSS 804.

The top of the compacted subgrade should be graded smooth with a minimum crossfall of 3% towards subdrains. Continuity of drainage should be maintained at transitions from existing pavement to new pavement.

6.2 Cold Creek Bridge

6.2.1 Preliminary Foundation Design

The existing Columbia Way bridge over Cold Creek may require widening and/or replacement as part of the roadway reconstruction project.

The stratigraphy encountered in Borehole 20-08 drilled at the bridge location consisted of a pavement structure and embankment fill extending to a depth of 4.1 m (Elev. 224.0), underlain by firm alluvial clay to a depth of 7.2 m (Elev. 221.0), overlying compact to very dense sand to the exploration depth of 12.6 m. Groundwater was measured in the monitoring well at a depth of 2.0 m (Elev. 226.2). In general, the water level in Borehole 20-08 near Cold Creek is expected to be governed by the prevailing water level in the creek. A water level of 4.2 m (Elev. 223.9) was recorded in Cold Creek at the Columbia Way bridge at the time of the drilling investigation.

Based on the borehole data, the preferred means of supporting the replacement bridge comprises steel H-piles driven into the very dense sand. For preliminary design purposes, a factored geotechnical resistance at ULS of 1,000 kN and a factored geotechnical resistance at SLS of 800 kN are recommended for HP310x110 piles expected to achieve the design resistances at a pile tip depth in the order of 18 m (Elev. 182.0). Additional investigation below the depth of current exploration will be required to confirm the geotechnical resistance values and pile tip depth.

Suitable bearing strata for support of spread footings is available at a depth of approximately 7.2 m (Elev. 221.0). Excavation for footing construction would need to extend through the firm alluvial clay deposits and into the sand below the creek water level. Cofferdam installation and advanced dewatering would be necessary to enable construction of footings in the dry. Factored geotechnical resistances of 450 kPa at ULS and 300 kPa at SLS may be employed for preliminary design of spread footings on the compact to very dense sand at this level. In view of the high groundwater conditions, spread footings may not be a preferred foundation option to support this structure.

Augered caissons extended to the sand below a depth of approximately 7.2 m could be considered at this site. However, installation of caissons may be problematic due the presence of cohesionless sand deposits and a high groundwater level. Construction will require use of a steel liner to maintain stability of the caisson sidewalls as well as techniques such as drilling slurry to prevent disturbance of the caisson base. As a result, the use of caissons does not appear to provide an advantage over driven piles, and is not recommended from a geotechnical viewpoint.

The impact of new foundation construction on the existing bridge foundations should be considered if widening of the existing bridge is planned. Installation of driven H-piles or cofferdam sheet piles could result in settlement of existing spread footings if present, and a monitoring program and/or mitigative measures such as pre-augering may be required. The design of the existing bridge foundations should be determined prior to development of the new foundation system.

The high groundwater level measured in the monitoring well suggests that an artesian condition exists at the bridge site. Selection of the foundation type and assessment of dewatering requirements must consider the potential presence of artesian pressure. The impact of dewatering on local water wells or other groundwater resources in the area would also need to be assessed prior to construction.

6.2.2 Abutment Backfill and Lateral Earth Pressures

Backfill behind bridge abutments should consist of non-frost susceptible, free-draining granular material conforming to OPS Granular A or Granular B Type II specifications.

The lateral earth pressures acting on the walls, assuming full drainage from behind the walls, may be calculated from the following expression:

$$p_h = K(\gamma h + q)$$

Where:
p_h = horizontal pressure on the wall at depth h (kPa)
K = earth pressure coefficient (see table below)
γ = unit weight of retained soil (see table below)
h = depth below top of fill where pressure is computed (m)
q = value of any surcharge (kPa)

Table 6.2 lists unfactored parameters for design purposes, assuming an essentially level ground surface behind and in front of the walls.

Table 6.2: Unfactored Earth Pressure Parameters

Retained Material	Unit Weight (kN/m^3)	Friction Angle (degrees)	Earth Pressure Coefficient		
			Active (K_a)	At-rest (k_o)	Passive (K_p)
Granular A or B Type II	22.8	35	0.27	0.43	3.7
Granular B Type I	21.2	32	0.31	0.47	3.3

If lateral movement is not permissible and/or the wall is restrained from lateral yielding, the at-rest earth pressure coefficient, K_o, should be used. If the wall design allows lateral yielding (non-rigid structure), the active earth pressure coefficient, K_a, may be used.

The earth pressure coefficients in the table above do not include potential compaction effects that must be included in the design. Compaction effects should be considered as per the CHBDC.

Design of the structures must incorporate measures such as weepholes to permit drainage of the backfill and avoid potential build-up of hydrostatic pressures behind the walls.

6.3 Tributary Culvert

It is understood that the existing corrugated steel pipe (CSP) culvert at the tributary located approximately 0.9 km east of Highway 50 may be extended or replaced with a wider and longer culvert as part of the roadway reconstruction project.

One borehole (Borehole 20-03) was drilled at the location of the existing CSP. The subsurface stratigraphy encountered in this borehole consisted of a pavement structure over silty clay fill to a depth of 4.1 m (Elev. 253.8) underlain by native silty clay till from a depth of 4.1 m (Elev. 253.8) to the exploration depth of 11.3 m (Elev. 246.7). Groundwater was measured at a highest level of 5.3 m (Elev. 252.7).

Based on the borehole information, an extension of the existing CSP or a new CSP or box culvert should be placed on the very stiff to hard silty clay below the level of the fill, at or below Elev. 253.8. A minimum 300 mm thick layer of Granular A bedding material should be provided under the base of the CSP or box culvert. Alternatively, an open footing culvert may be supported on spread footings founded on very stiff native clay at or below 4.1 m depth (Elev. 253.8) and designed using factored geotechnical resistances of 350 kPa at ULS and 225 kPa at SLS.

Use of a hydraulic excavator should be suitable for excavation in the fill and native materials. The selection of the method of excavation is the responsibility of the contractor and must be based on their equipment, experience and interpretation of the site conditions. The fill, sand and gravel, and till deposits may contain cobbles, boulders and other obstructions and the contractor must be prepared to handle these obstructions

Construction dewatering is not expected to be an issue at the tributary culvert provided excavations are maintained within the silty clay and temporary stream diversion measures are provided seasonally as required.

6.4 Frost Cover

The depth of frost penetration at this site is approximately 1.4 m. All spread footings or pile caps should be provided with a minimum of 1.4 m of earth cover as protection against frost action.

6.5 Slope East of Forest Gate Avenue

The approximate 130 m long section of Columbia Way descending into the Cold Creek valley easterly from approximately 350 m east of Forest Gate Avenue appears to have been constructed by partial fill placement and earth cut along the side of a hill. An approximate 10 to 12 m high slope is present along the north (downhill) side of the road and an 8 to 10 m high cut slope is present on the south (uphill) side of the roadway. Downslope movement and tilting of the guiderail is evident along the crest of the north slope.

The soil stratigraphy encountered in Borehole 20-07 completed in this section of the roadway comprised a pavement structure over silty clay fill extending to 4.1 m depth (Elev. 238.7), underlain by native compact to very dense silt, silty sand and sandy silt to the termination depth of 15.5 m (Elev. 227.4). Groundwater was measured in a monitoring well at a depth of 13.3 m (Elev. 230.5) below the road surface.

Preliminary review of existing slope grades indicates that the overall slope inclination is in the order of 3H:1V, with steeper sections in the order of 2.5H:1V to 2.0H:1V created by road construction. Localized areas inclined at approximately 1H:1V are presented at the top of slope adjacent to the road. Preliminary stability analysis of the slope (Figure F1, Appendix F) indicates that the overall stability of the slope is not a concern, however measures are required to address movement and tilting of the guiderail in the steepened section of slope adjacent to the road.

For conceptual design, the following remedial measures may be considered to stabilize the slope and guiderail, and enable widening of the roadway if required:

- Flatten the steep section of the downhill slope by placement of additional fill to establish an inclination no steeper than 2H:1V. This option would require removal of the existing vegetation and benching of the existing slope prior to placement of the additional fill.

- Construct a retaining wall or install sheet piling along the north side of the road to support the roadway, shoulder and guiderail at the current alignment.

- Excavate and reconstruct the existing roadway embankment fill as a reinforced soil slope inclined at an inclination steeper than 2H:1V and benched into the native soil slope.

- Shift the road alignment to the south by cutting further into the uphill slope. For preliminary design, we would recommend slope inclinations no steeper than 2H:1V. If this inclination is not achievable due to property impacts, it would be recommended to implement similar remedial measures as suggested for the north slope, such as a retaining wall, sheet pile wall or reinforced soil slope.

The preferred option will depend on economic considerations and property constraints. Additional borehole investigation and stability analyses will be required during detailed design to confirm the required slope geometry and design parameters.

For preliminary design, standard slope inclinations no steeper than 2H:1V may be assumed for sections of reconstructed slopes. Mid-height berms comprising 2 m wide benches must be incorporated along the length of embankments with heights exceeding 6 m. Cut or fill slopes must be provided with erosion protection in accordance with OPSS.PROV 804. To minimize the potential for erosion, surface water should be directed away from the embankment slopes and conveyed down the slope in appropriately designed drainage channels.

6.6 Cut Slope west of Caledon-King Townline

Columbia Way passes through an approximately 7 to 8 m high cut section immediately west of Caledon-King Townline. The cut slope on the north side appears to be inclined near 2H:1V and is vegetated by grass. The cut slope on the south side is inclined at 1H:1V to near-vertical and comprises an active eroding slope face in the form of rills and gullies. No ditching is present along the roadsides, and eroded material washes onto the south side of the road. The areas at the top of both slopes appear well vegetated with mature trees, shrubbery and grasses.

The subsurface stratigraphy encountered Borehole 20-09, drilled on the roadway, consisted of a surficial pavement structure underlain by native hard silty clay overlying very dense silt. Based on the surficial geology mapping and visual review of the eroded slope face, the cut slope above the road level is expected to comprise glacial clay till.

Based on the borehole findings and site examination, roadway improvements through the cut section should include provision of drainage ditches at the toe of slope along both sides of the road and re-establishment of the cut slopes at an inclination no steeper than 2H:1V. Cut slopes greater than 6 m in height should be provided with a 2 m wide mid-height berm.

Additional boreholes should be drilled from the top of the slopes during detailed design to confirm the assumed stratigraphy, and slope stability analyses completed to confirm the stability of the recommended slope inclination.

The cut slopes must be provided with erosion protection in accordance with OPSS.MUNI 804. Typically, this will comprise a vegetation cover established on all exposed earth surfaces. Surface water runoff at the slope crest should be directed away from the slope face.

6.7 Municipal Service Installation

In general, excavation for open cut installation of municipal services to an assumed maximum depth of 3.0 m will extend through the existing roadway pavement structure, sand and clay fill materials, and into native silty clay, silty clay till and silt. Use of a hydraulic excavator should be suitable for trench excavation within these materials.

All temporary excavations must be carried out in accordance with the current Occupational Health and Safety Act (OHSA) of Ontario and local regulations. In general, the native soils are classified as Type 3 soils above the groundwater level, and Type 4 soils if excavation extends below the water level without prior dewatering. Groundwater is not expected to pose construction issues during excavation of relatively shallow trenches.

Prior to placement of the pipe bedding, the base of the trench should be maintained in a dry condition, free of loose or disturbed material. The pipe must be placed on a uniformly competent subgrade. Pipe bedding materials, compaction and cover should follow OPSD 802.030 to 803.034, and/or Town of Caledon specifications.

Trench backfill materials should be placed in loose lift thicknesses not exceeding 200 mm and compacted to at least 98% of its SPMMD. Where utility trenches are located beneath the roadway, OPSS Granular A or B material, or unshrinkable fill should be employed as backfill.

For trenches located outside of the roadway, the portion of the trench above the pipe cover can be backfilled with excavated soil provided it is unfrozen and free of organics, debris and other deleterious materials. The placement moisture content should be within about 2% of the optimum moisture content for efficient compaction, and the till must be adequately broken down and compacted in the trench.

6.8 Geoenvironmental Considerations

The chemical sampling and testing program carried out during this investigation was completed for due diligence purposes to obtain a general understanding of the environmental quality of the soils on site. The environmental characteristics of the soils were inferred from a limited number of samples and sampling locations, and the extent of materials that may be encountered during construction was not delineated. As such, the environmental data and comments are provided as guidance to the contractor on the requirements for reuse or disposal of materials generated during construction and should not be used to estimate quantities.

Where excavation of existing pavement structures is required, the asphalt from the existing pavement structure may be separated for transfer to a recycling facility, although asbestos testing should be carried out prior to stripping. Asphalt should not be mixed with excess soil as fill receivers may not accept excess soils containing asphalt. Excavated road granular materials may be reused on site for general fill purposes subject to geotechnical approval and verification analytical testing.

The results of the analytical laboratory testing indicate that the concentrations of the tested parameters met MECP Table 2 and Table 8 Standards with the exception of electrical conductivity (EC).

Comparison to the Table 1 RPI/ICC and Table 2.1 RPA ESQS indicate the concentrations of the tested parameters met the Standards with the exceptions of EC and sodium adsorption ratio (SAR).

Elevated EC and SAR are likely the result of de-icing activities on the roadway. The presence of SAR or EC does not impose a risk to human health, but rather may only impact the physical composition of the soil which could affect the growth of vegetation. Where salt has been applied on a highway for the purposes of keeping the highway safe for traffic under conditions of snow or ice or both, the applicable site conditions standard is deemed not to be exceeded under Section 48 (3) of O. Reg. 153/04.

In this regard, the EC and SAR impacted materials that are free of staining and odour may generally be suitable for reuse on Site provided the excavated materials are appropriate from a geotechnical perspective, or possibly reused off-site at properties requiring fill for a beneficial purpose. Prior to reuse, the environmental quality of embankment fills should be checked to verify the appropriate end use of the materials. This can be completed through additional testing prior to construction, or screened during construction through segregating into separate stockpiles, and sampled and tested.

There may be restrictions to the on- and off-site re-use of the fill materials due to the marginally elevated SAR value (e.g. placed in areas more than 30 m from the waterbody, 2 m from the groundwater table, and at least 100 m from a potable water supply etc.). Receiving site authorities will need to be notified of the salt-related impacts and provide consent in writing of their acceptance of the materials.

A more comprehensive level of testing should be carried out for the off-site reuse of excess fill or native soils to verify that the environmental quality of the excess soils meets the site’s analytical requirements and the requirements of O. Reg. 406/19 and the Excess Soil Quality Standards. In this regard and depending on the project design details, management strategies and receiving site requirements, the documentation and sampling and testing criteria of O. Reg. 406/19 may need to be met.

Alternatively, the excavated materials may be disposed of off-site at a licensed landfill facility with an ECA to receive this waste type. TCLP analysis will be required during construction on the actual materials to be disposed, if any, to verify the waste classification and the acceptance criteria of the waste management facility selected by the Contractor has been met.

Additional analytical testing of excavated soils will be required during detailed design to further evaluate the environmental quality of the soil and confirm reuse and disposal requirements.

The “new” O. Reg. 406/19 may or may not apply to the infrastructure project subject to specific design details (i.e. excavated quantities, soil management strategies involving excess soils that are to be reused off-site, receiving site analytical requirements). If the regulation applies, additional documentation, sampling and testing procedures (including prescribed leachate analysis) may be required to meet the criteria of O. Reg. 406/19. The regulation does not apply to the reuse of excavated soils on Site, and the project may be exempt from the registration, planning and sampling requirements of the regulation if excess soils are to be reused as part of another infrastructure project owned by the Project Leader (as defined by the Regulation) or public body.

No statement made herein should be construed as relieving the Contractor’s responsibility to comply with all applicable federal and provincial regulations, municipal by-laws and guidelines related to the handling or disposal of excavated materials (and/or discharge of extracted groundwater).

6.9 Detailed Geotechnical Investigation

The information presented in this report is provided for preliminary design and planning purposes only. Detailed geotechnical investigation will be required to confirm the subsurface conditions and recommendations. This work should incorporate:

- A detailed pavement investigation including additional boreholes within the existing roadway pavement and widening areas to further define the subgrade conditions and confirm the pavement design recommendations;
- Boreholes within the envelope of all bridge foundation units to confirm the subsurface conditions at the structure location and develop detailed geotechnical recommendations for design and construction of the bridge foundations. This should include further investigation of the potential artesian groundwater condition;
- Additional investigation and stability analysis of the slopes to the east of Forest Gate Avenue and west of Caledon-King Townline;
- Further assessment of dewatering requirements and the need for a PTTW; and
- Supplemental chemical testing to confirm the requirements for reuse or disposal of excavated material.

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Appendix A

Site Photographs

Photograph 1 – Columbia Way and Highway 50 intersection looking west

Photograph 2 – Columbia Way looking east at Borehole 20-02

Photograph 3 – Columbia Way looking east at Borehole 20-03

Photograph 4 – View of culvert looking north approximately 0.9 km east of Highway 50

Photograph 5 – View of south slope at culvert approximately 0.9 km east of Highway 50

Photograph 6 – Columbia Way looking west at Borehole 20-04

Photograph 7 – Columbia Way looking west at Borehole 20-05

Photograph 8 – Columbia Way looking east at Borehole 20-06

Photograph 9 – Columbia Way looking east at Borehole 20-07

Photograph 10 – Columbia Way looking south at upslope near western limit

Photograph 11 – Trees on upslope near eastern limit

Photograph 12 – Columbia Way looking west at eastern limit of upslope

Photograph 13 – View of guardrail looking south towards guardrail movement

Photograph 14 – Guardrail and downslope on north side of roadway

Photograph 15 – Vegetation and slope inclination on downslope

Photograph 16 – Bridge on Columbia way at Borehole 20-08 looking west over Cold Creek

Photograph 17 – Columbia Way looking west from Borehole 20-09

Photograph 18 – Columbia Way and Caledon-King Townline South intersection looking east

Photograph 19 – View of slope south of Columbia Way looking west near Borehole 20-09

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Appendix B

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT(1) ‘N’ VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

1) Laboratory Triaxial Testing
2) Field Insitu Vane Testing
3) Laboratory Vane Testing
4) SPT value
5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT “N” VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample	
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight		RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT ‘N’ Value Standard Penetration Test ‘N’ Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to “A” size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

RECORD OF BOREHOLE 20-01

PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 2, 2020
COMPLETED : September 2, 2020
N 4 860 644.4 E 600 098.2

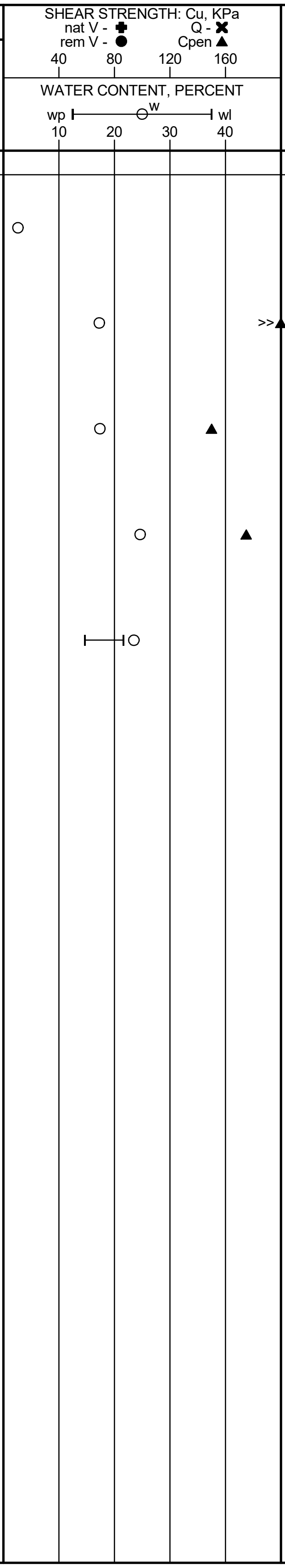
Project No. 27855
SHEET 1 OF 1
DATUM Geodetic

BORING METHOD: Solid Stem Augers

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	262.64
ASPHALT (50mm)	
SAND and **GRAVEL**, some silt, brown, moist: (FILL)	0.05
CLAY, silty, some sand, trace gravel, very stiff, brown: (TILL)	261.88 0.76
SILT, sandy, some clay, compact, grey, moist; with occasional silty clay seams	259.67 2.97
END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE, ASPHALT AT SURFACE.	258.98 3.66

NUMBER	TYPE	BLOWS/0.3m	COMMENTS
1	GS		Grain Size Analysis: Gr 43%/ Sa 43%/ Si & Cl 14%
2	SS	15	
3	SS	13	
4	SS	8	
5	SS	12	Grain Size Analysis: Gr 1%/ Sa 29%/ Si 59%/ Cl 11%

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE (metres): 1 2 3 4 5 6 7 8 9

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : GS
CHECKED : KF

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RECORD OF BOREHOLE 20-02

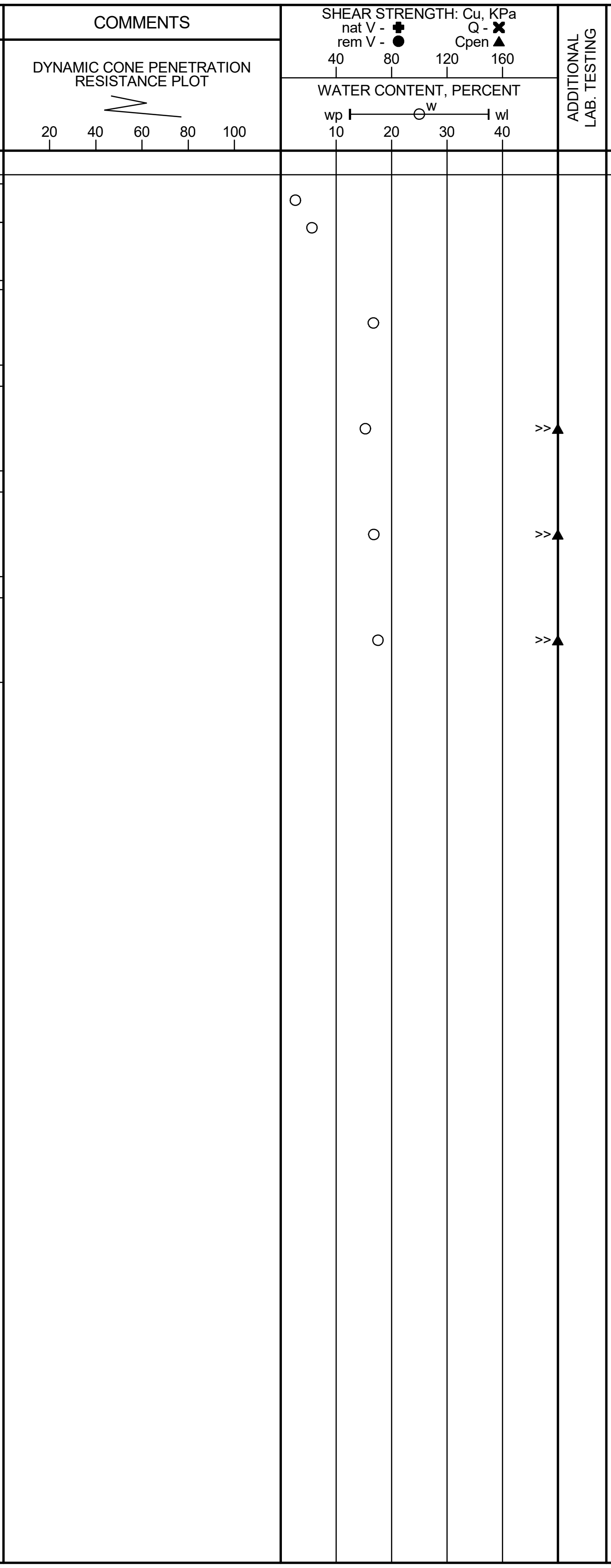
PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 2, 2020
COMPLETED : September 2, 2020

N 4 860 940.0 E 600 362.2

Project No. 27855
SHEET 1 OF 1
DATUM Geodetic

BORING METHOD: Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	264.48			
ASPHALT (60mm)	0.06			
SAND and **GRAVEL**, some silt, brown, moist: (FILL)		1	GS	
	263.72 0.76	2	GS	
CLAY, silty, some sand, trace gravel, very stiff to hard, brown: (TILL)		3	SS	19
		4	SS	31
		5	SS	37
	260.82 3.66	6	SS	32
END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE, ASPHALT AT SURFACE.				



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE (metres): 1, 2, 3, 4, 5, 6, 7, 8, 9

GROUNDWATER ELEVATIONS
▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : GS
CHECKED : KF

RECORD OF BOREHOLE 20-03

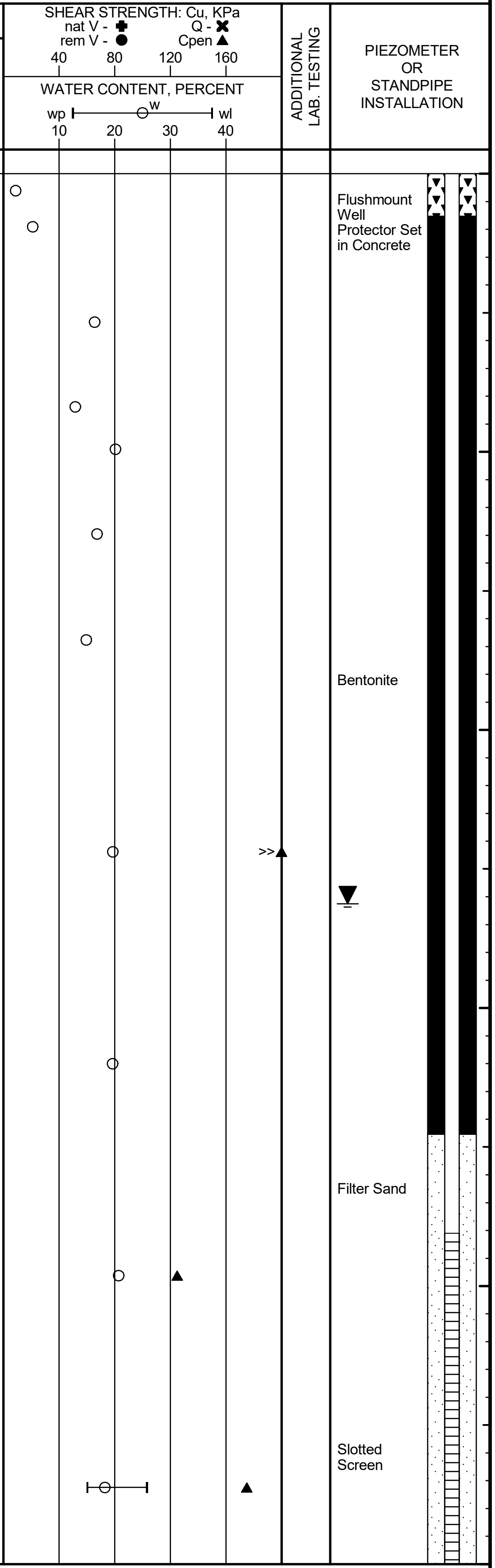
PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 2, 2020
COMPLETED : September 2, 2020
N 4 861 057.7 E 600 699.3

Project No. 27855
SHEET 1 OF 2
DATUM Geodetic

BORING METHOD: Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	257.95
ASPHALT (50mm)	0.05
SAND and **GRAVEL**, trace silt, brown, moist: (FILL)	
CLAY, silty, some sand, trace gravel, stiff, brown; occasional organic inclusions	257.19 0.76
CLAY, silty, trace sand, very stiff to hard, brown	253.84 4.11

SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS
1	GS		Grain Size Analysis: Gr 33%/ Sa 61%/ Si & Cl 6%
2	GS		
3	SS	12	
4	SS	13	
5	SS	15	
6	SS	14	
7	SS	26	
8	SS	35	
9	SS	16	
10	SS	18	Grain Size Analysis: Gr 0%/ Sa 6%/ Si 66%/ Cl 28%



DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

DEPTH SCALE (metres): 1 2 3 4 5 6 7 8 9

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER
October 2, 2020

LOGGED : GS
CHECKED : KF

RECORD OF BOREHOLE 20-03

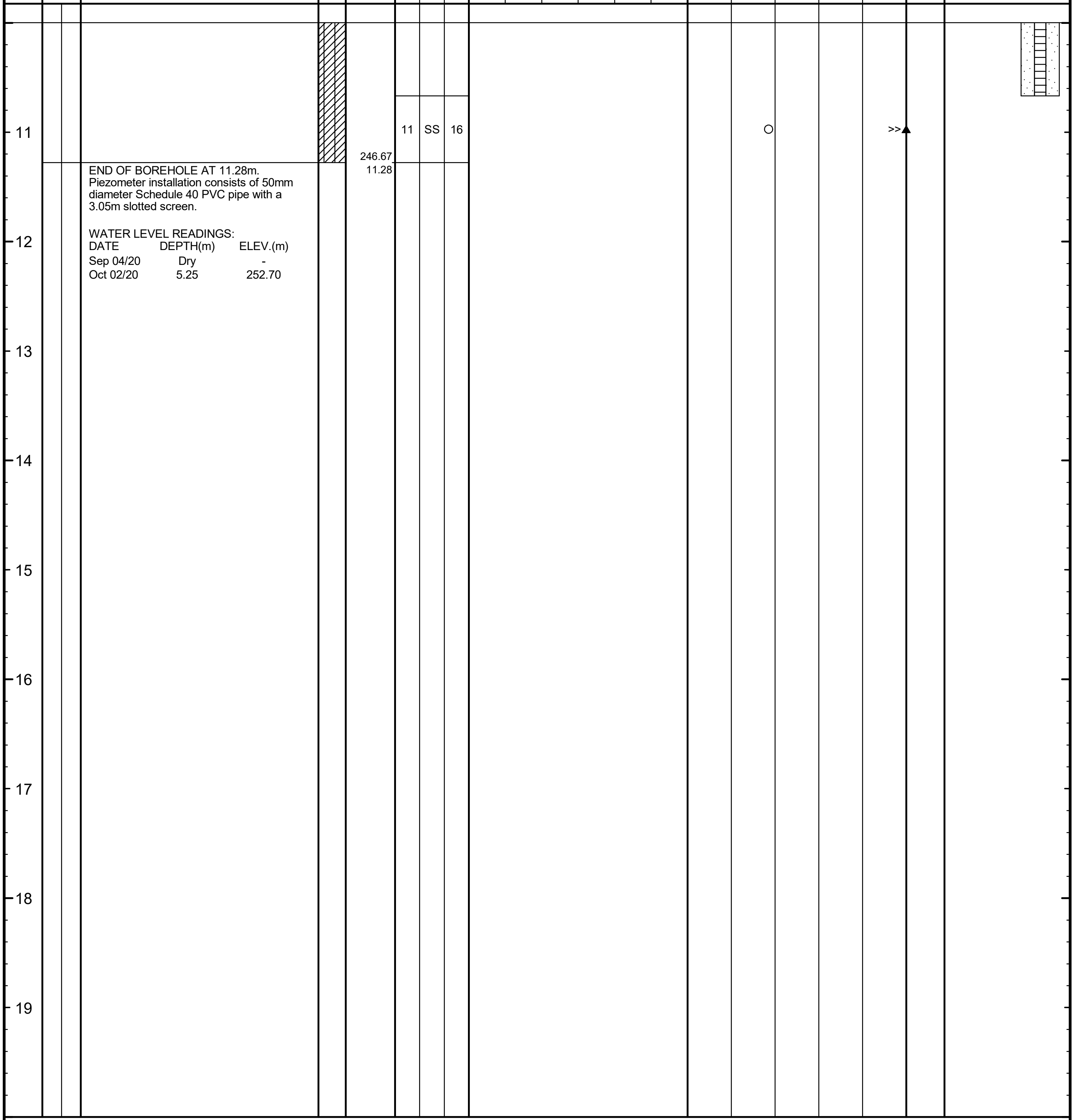
PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 2, 2020
COMPLETED : September 2, 2020
N 4 861 057.7 E 600 699.3

Project No. 27855
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ rem V - ● Q - ✖ Cpen ▲ 40 80 120 160 / WATER CONTENT, PERCENT wp ⊢ ○w ⊣ wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
11			▨		11	SS	16		○ >>▲		
		END OF BOREHOLE AT 11.28m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.		246.67 11.28							

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Sep 04/20	Dry	-
Oct 02/20	5.25	252.70



GROUNDWATER ELEVATIONS

∇ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
October 2, 2020

LOGGED : GS
CHECKED : KF

THURBER

RECORD OF BOREHOLE 20-04

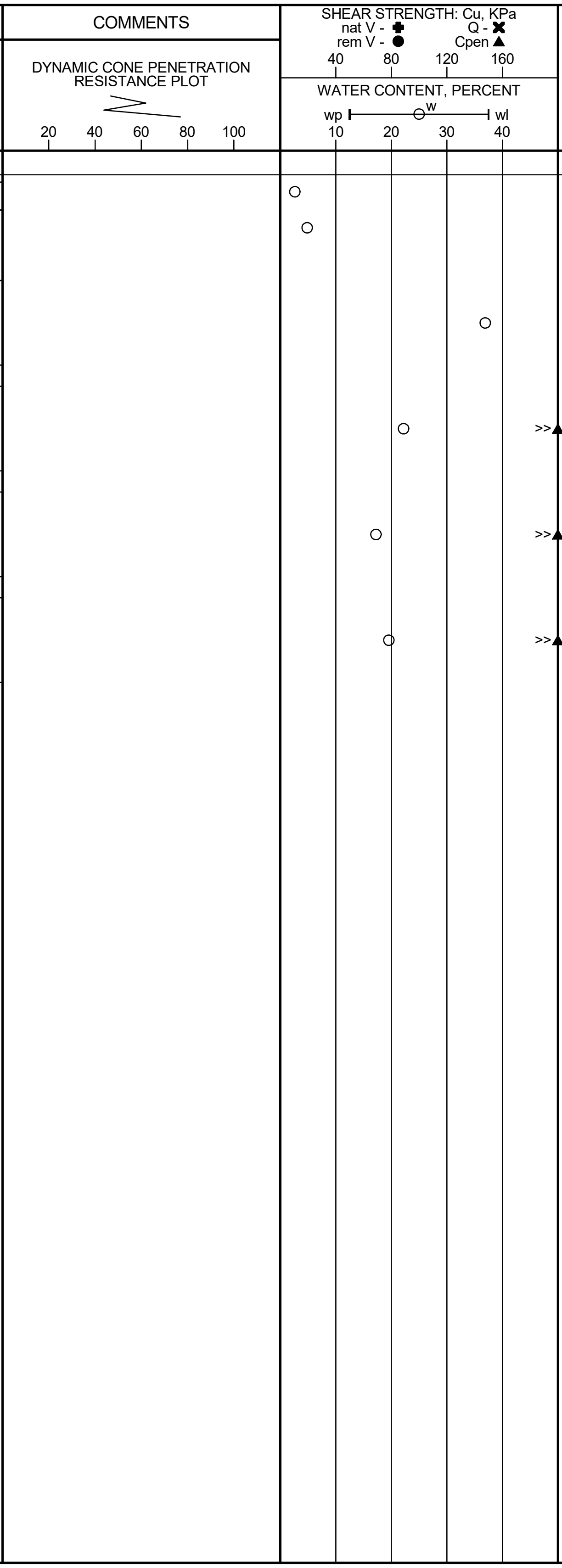
PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 2, 2020
COMPLETED : September 2, 2020
N 4 861 169.5 E 601 060.3

Project No. 27855
SHEET 1 OF 1
DATUM Geodetic

BORING METHOD: Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	262.88
ASPHALT (50mm)	0.05
SAND and **GRAVEL**, trace to some silt, brown, moist: (FILL)	262.12 0.76
CLAY, silty, some sand, trace gravel, stiff, brown	261.44 1.45
CLAY, silty, some sand, trace gravel, very stiff, brown: (TILL)	259.23 3.66
END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE, ASPHALT AT SURFACE.	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	GS	
2	GS	
3	SS	12
4	SS	17
5	SS	27
6	SS	29



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS
▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : GS
CHECKED : KF

THURBER

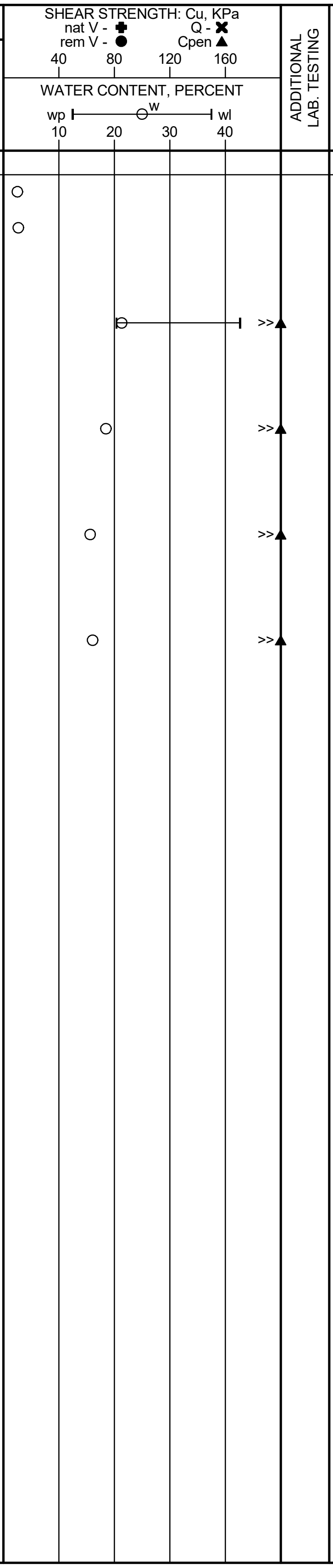
RECORD OF BOREHOLE 20-05

PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 3, 2020
COMPLETED : September 3, 2020
N 4 861 413.6 E 601 279.7

Project No. 27855
SHEET 1 OF 1
DATUM Geodetic

BORING METHOD: Solid Stem Augers

DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
GROUND SURFACE	262.32				
ASPHALT (35mm)	0.04	1	GS		
SAND and **GRAVEL**, trace to some silt, loose, brown, moist: (FILL)		2	GS		
CLAY, silty, some sand, trace gravel, stiff, brown	261.56 0.76	3	SS	11	Grain Size Analysis: Gr 0%/ Sa 11%/ Si 46%/ Cl 43%
CLAY, silty, some sand, trace gravel, very stiff to hard, brown: (TILL)	260.87 1.45	4	SS	17	
		5	SS	29	
		6	SS	50	
END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE, ASPHALT AT SURFACE.	258.66 3.66				



PIEZOMETER OR STANDPIPE INSTALLATION

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

DEPTH SCALE (metres) 1 2 3 4 5 6 7 8 9

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : GS
CHECKED : KF

THURBER

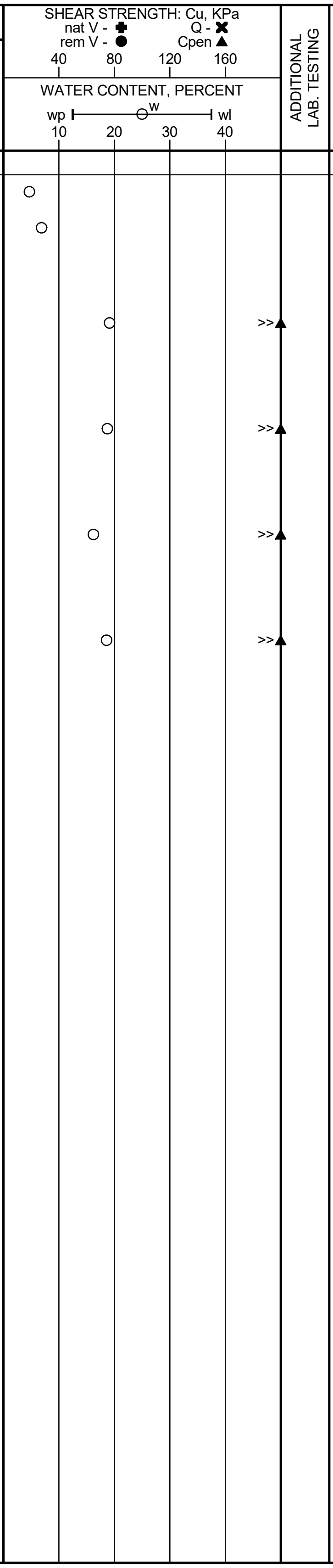
RECORD OF BOREHOLE 20-06

PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 3, 2020
COMPLETED : September 3, 2020
N 4 861 640.1 E 601 465.3

Project No. 27855
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE	257.05			
	Solid Stem Augers	**ASPHALT** (50mm)	0.05			
		SAND and **GRAVEL**, some silt, grey, moist: (FILL)		1	GS	
			256.36 0.69	2	GS	
1		**CLAY**, silty, some sand, trace gravel, stiff to very stiff, brown, moist: (TILL)		3	SS	13
2				4	SS	20
				5	SS	16
3				6	SS	22
			253.39 3.66			
4		END OF BOREHOLE AT 3.66m. WATER LEVEL AND CAVE AT 2.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE, ASPHALT AT SURFACE.				
5						
6						
7						
8						
9						

COMMENTS
DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100



PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : GS
CHECKED : KF

THURBER

RECORD OF BOREHOLE 20-07

PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 3, 2020
COMPLETED : September 3, 2020
N 4 861 884.2 E 601 602.1

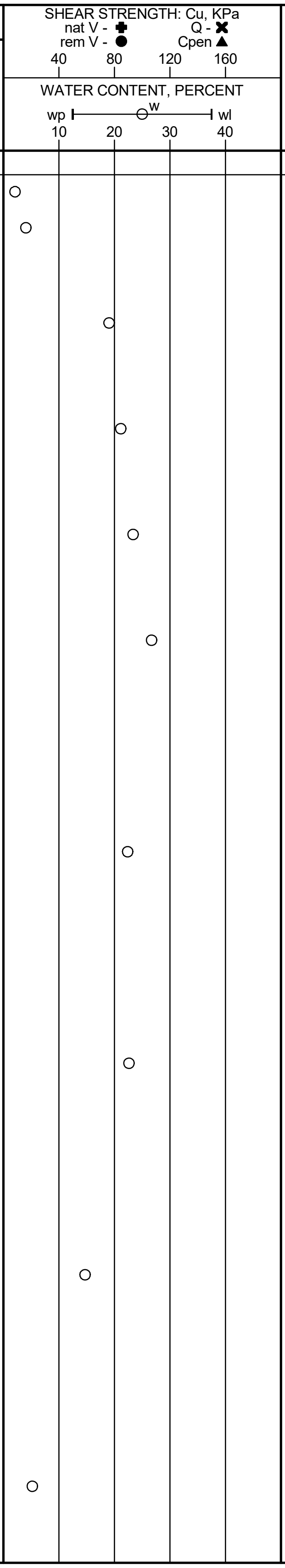
Project No. 27855
SHEET 1 OF 2
DATUM Geodetic

BORING METHOD: Solid Stem Augers

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	242.83
ASPHALT (50mm)	0.05
SAND and **GRAVEL**, trace silt, brown, moist: (FILL)	242.14 0.69
CLAY, silty, some sand, trace gravel, firm to stiff, brown: (FILL)	238.71 4.11
SILT, some clay to clayey, trace to some sand, compact to dense, brown, moist; with occasional partings of silty clay	234.14 8.69
SAND, silty, very dense, brown, moist	232.83

NUMBER	TYPE	BLOWS/0.3m	COMMENTS
1	GS		Grain Size Analysis: Gr 36%/ Sa 56%/ Si & Cl 8%
2	GS		
3	SS	9	
4	SS	8	
5	SS	7	
6	SS	10	
7	SS	29	
8	SS	23	
9	SS	37	
10	SS	88/ 0.275	Grain Size Analysis: Gr 0%/ Sa 75%/ Si 24%/ Cl 1%

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION:
Flushmount Well Protector Set in Concrete
Bentonite

DEPTH SCALE (metres): 1 2 3 4 5 6 7 8 9

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER
October 2, 2020

LOGGED : GS
CHECKED : KF

THURBER

RECORD OF BOREHOLE 20-07

PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 3, 2020
COMPLETED : September 3, 2020
N 4 861 884.2 E 601 602.1

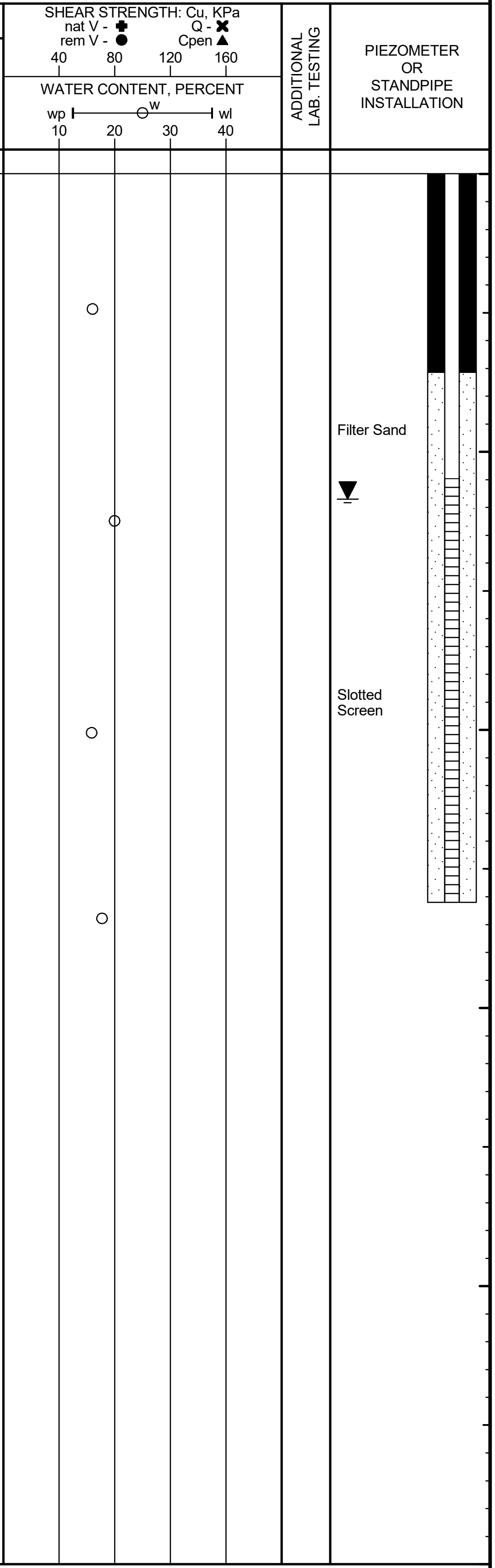
Project No. 27855
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m
10	Solid Stem Augers	**SILT**, sandy, trace clay, very dense, brown, moist	10.00			
11				11	SS	81
12				12	SS	56
13						
14				13	SS	50/ 0.025
15		becoming grey, wet				
15.46			227.37 15.46	14	SS	86/ 0.200

END OF BOREHOLE AT 15.46m.
Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Sep 04/20	12.14	230.69
Oct 02/20	12.34	230.49



COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
October 2, 2020

LOGGED : GS
CHECKED : KF

THURBER

RECORD OF BOREHOLE 20-08

PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 1, 2020
COMPLETED : September 1, 2020
N 4 861 923.8 E 601 793.8

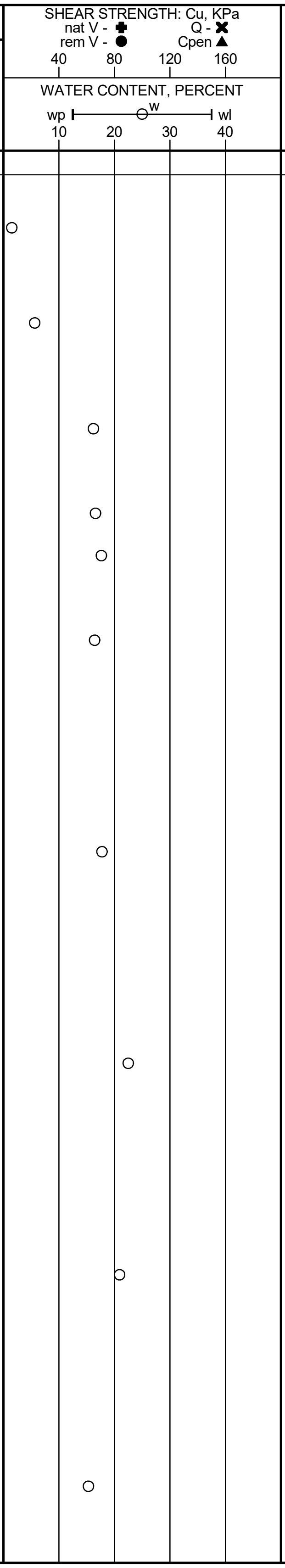
Project No. 27855
SHEET 1 OF 2
DATUM Geodetic

BORING METHOD: Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	228.13
ASPHALT (50mm)	0.05
SAND and **GRAVEL**, some silt to silty, compact, brown, moist: (FILL)	
CLAY, silty, some sand, trace gravel, firm to stiff, dark grey; occasional organic inclusions: (FILL)	226.72 1.40
SAND, silty, trace gravel, compact to very loose, black, wet; occasional organic inclusions: (FILL)	225.48 2.64
CLAY, silty, some sand, trace gravel, firm, black to grey; occasional organic inclusions (ALLUVIAL)	224.01 4.11
SAND, trace to some silt, compact to very dense, grey, wet	220.96 7.16

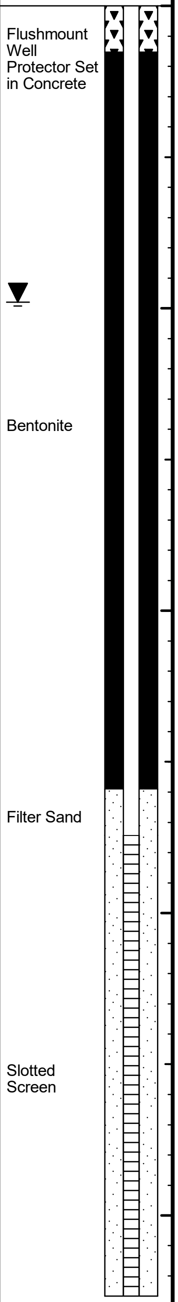
SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS
1	GS		
2	SS	16	
3	SS	7	
4	SS	11	
5	SS	2	
6	SS	6	
7	SS	6	
8	SS	28	Grain Size Analysis: Gr 0%/ Sa 91%/ Si 5%/ Cl 4%
9	SS	43	

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE (metres): 1 2 3 4 5 6 7 8 9

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
October 2, 2020

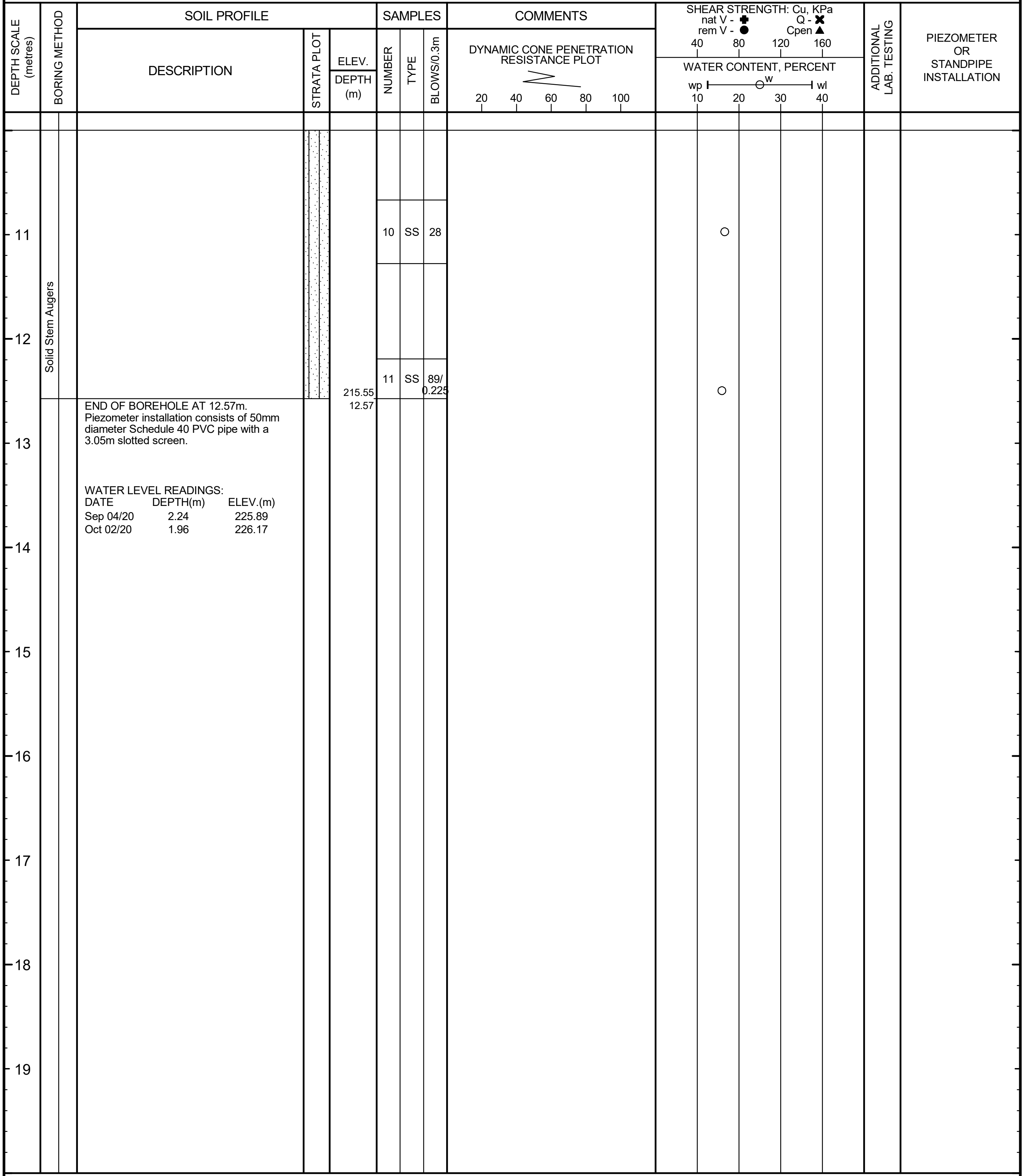
LOGGED : GS
CHECKED : KF

THURBER

RECORD OF BOREHOLE 20-08

PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 1, 2020
COMPLETED : September 1, 2020
N 4 861 923.8 E 601 793.8

Project No. 27855
SHEET 2 OF 2
DATUM Geodetic



NUMBER	TYPE	BLOWS/0.3m
10	SS	28
11	SS	89/ 0.225

215.55
12.57

END OF BOREHOLE AT 12.57m.
Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Sep 04/20	2.24	225.89
Oct 02/20	1.96	226.17

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
October 2, 2020

LOGGED : GS
CHECKED : KF

THURBER

RECORD OF BOREHOLE 20-09

PROJECT : Columbia Way EA
LOCATION : Columbia Way, Caledon, Ontario
STARTED : September 1, 2020
COMPLETED : September 1, 2020
N 4 862 218.2 E 602 026.8

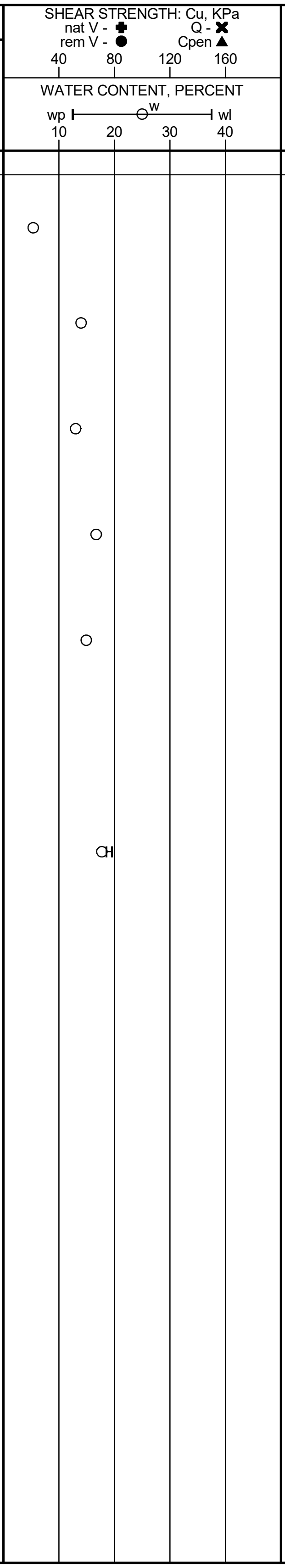
Project No. 27855
SHEET 1 OF 1
DATUM Geodetic

Boring method: Solid Stem Augers

DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
GROUND SURFACE	247.93				
ASPHALT (40mm)	0.04				
SAND and **GRAVEL**, trace silt, brown, moist: (FILL)		1	GS		
CLAY, silty, trace sand, hard, brown, moist	247.32 0.61	2	SS	84/ 0.175	
		3	SS	92/ 0.175	
		4	SS	84/ 0.175	
		5	SS	98/ 0.175	
SILT, trace sand, very dense, brown, moist	243.81 4.11	6	SS	100/ 0.200	Grain Size Analysis: Gr 0%/ Sa 1%/ Si 96%/ Cl 3%
END OF BOREHOLE AT 4.98m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.	242.95 4.98				

WATER LEVEL READINGS:

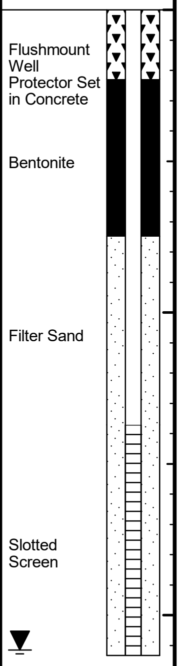
DATE	DEPTH(m)	ELEV.(m)
Sep 04/20	Dry	-
Oct 02/20	4.23	243.70



DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

DEPTH SCALE (metres): 1 2 3 4 5 6 7 8 9

ADDITIONAL LAB. TESTING



GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
October 2, 2020

LOGGED : GS
CHECKED : KF

THURBER

THURBER

Appendix C

Borehole Location Plans

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© 2020 Microsoft Corporation © 2020 Maxar ©CNES (2020) Distribution Airbus DS

LEGEND

⊕ BOREHOLE (BH) LOCATION

● BOREHOLE (BH) LOCATION WITH MONITORING WELL (MW)

0 metres 80

R.V. Anderson Associates Limited

CLASS EA STUDY FOR COLUMBIA WAY
BETWEEN HWY 50 & CALEDON-KING TOWNLINE
TOWN OF CALEDON, ONTARIO

BOREHOLE LOCATION PLAN

JOB# 27855

THURBER ENGINEERING LTD.

PREPARED :	DRAWN :	APPROVED :
KF	BH	MRA
DATE :	SCALE :	DRAWING No.
NOVEMBER 2020	1:2000	27855-1

FILENAME: H:\Drafting\27000\27855\TED-27855-BHPL.dwg
PLOTDATE: Nov 20, 2020 - 8:28 AM

LEGEND

⌖ BOREHOLE (BH) LOCATION

● BOREHOLE (BH) LOCATION WITH MONITORING WELL (MW)

0 metres 80

R.V. Anderson Associates Limited

CLASS EA STUDY FOR COLUMBIA WAY
BETWEEN HWY 50 & CALEDON-KING TOWNLINE
TOWN OF CALEDON, ONTARIO

BOREHOLE LOCATION PLAN

JOB# 27855

THURBER ENGINEERING LTD.

PREPARED :	DRAWN :	APPROVED :
KF	BH	MRA
DATE :	SCALE :	DRAWING No.
NOVEMBER 2020	1:2000	27855-2

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PLOTDATE: Nov 20, 2020 - 8:28 AM

Appendix D

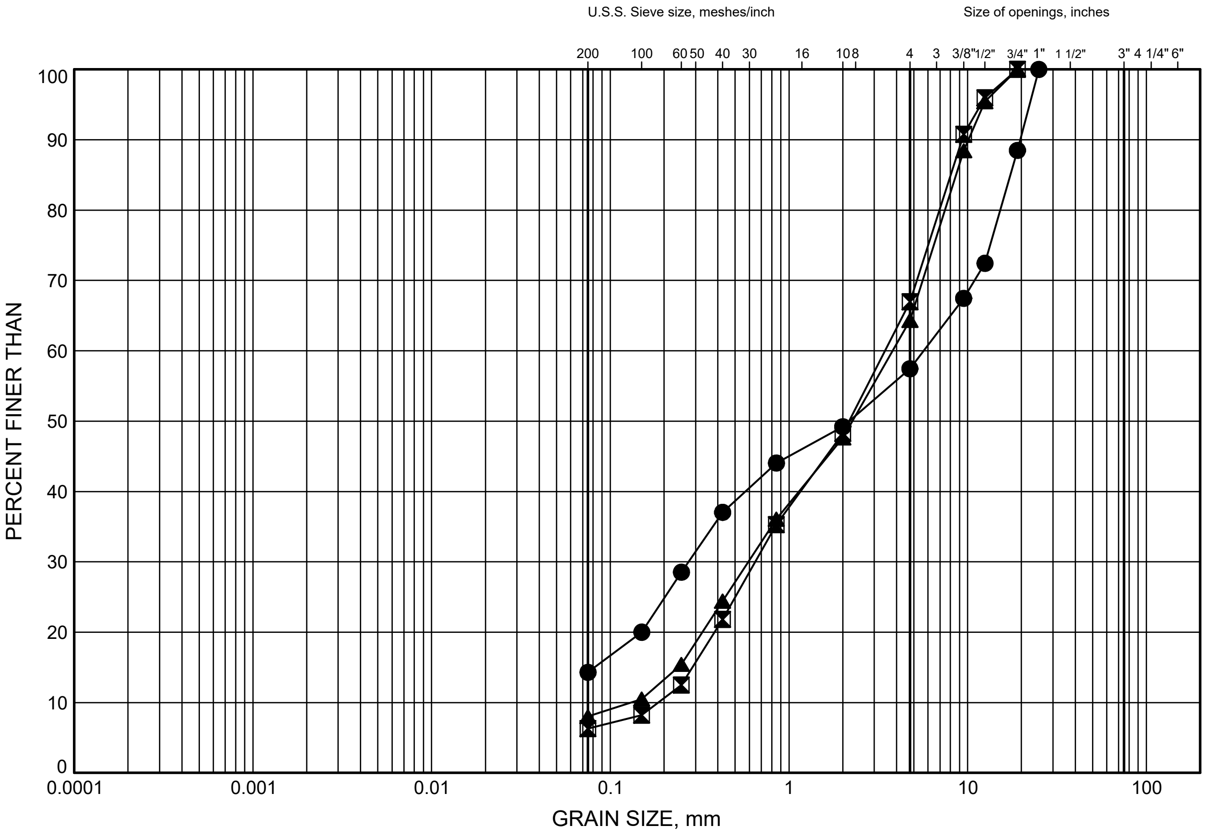
Geotechnical Laboratory Soil Test Results

Columbia Way EA

GRAIN SIZE DISTRIBUTION

FIGURE D1

GRANULAR



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	20-01	0.38	262.26
⊠	20-03	0.12	257.83
▲	20-07	0.15	242.68

Date November 2020

Project 27855

THURBER

Prep'd AN

Chkd. KF

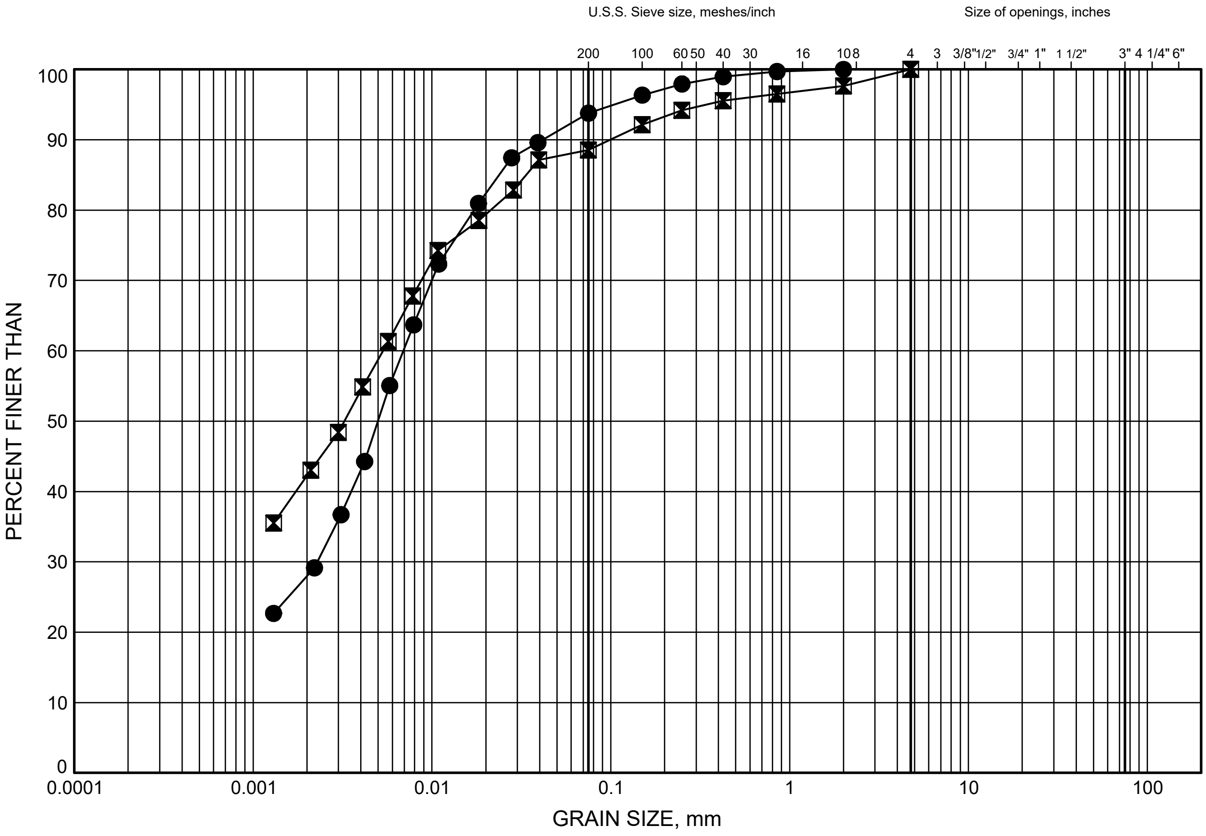
GRAIN SIZE DISTRIBUTION - THURBER TEL-27855.GPJ 11/11/20

Columbia Way EA

GRAIN SIZE DISTRIBUTION

FIGURE D2

CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	20-03	9.45	248.50
☒	20-05	1.07	261.25

GRAIN SIZE DISTRIBUTION - THURBER TEL-27855.GPJ 11/11/20

Date November 2020

Project 27855

THURBER

Prep'd AN

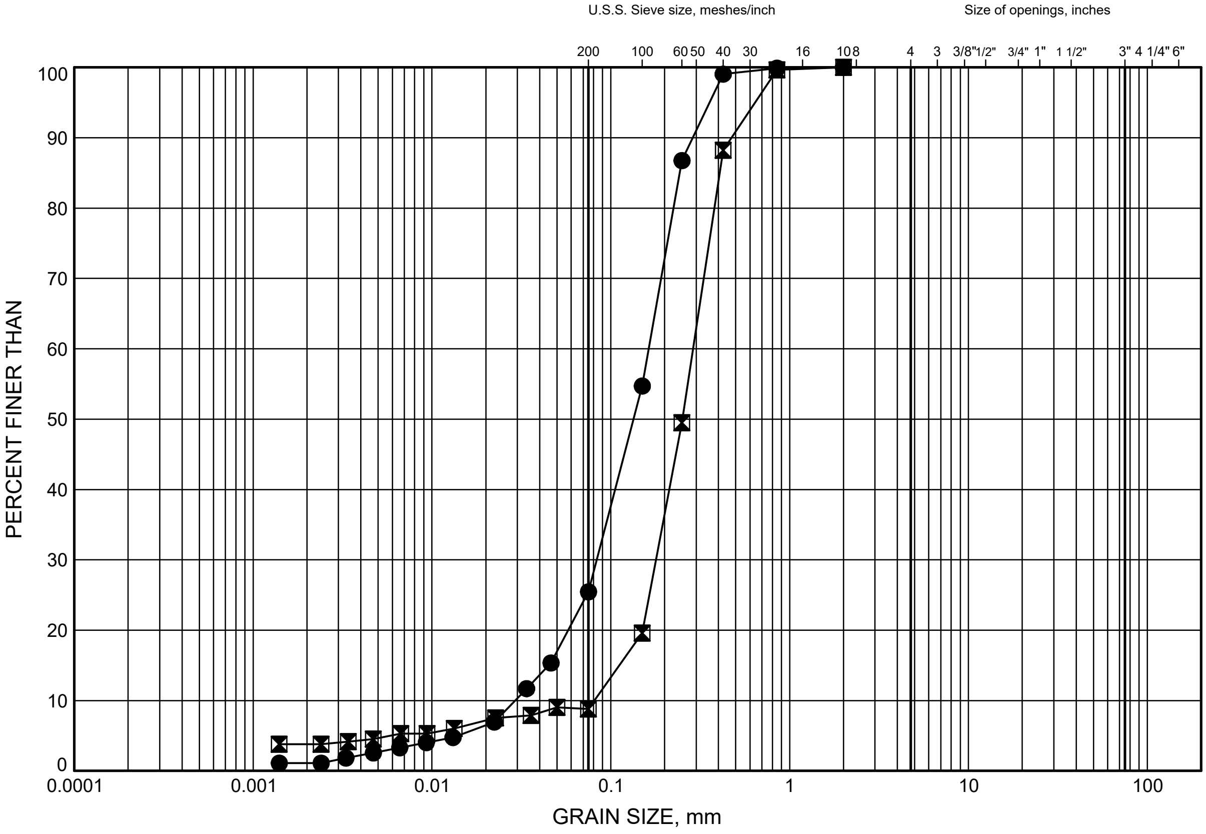
Chkd. KF

Columbia Way EA

GRAIN SIZE DISTRIBUTION

FIGURE D3

SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	20-07	9.45	233.38
☒	20-08	7.92	220.20

Date November 2020

Project 27855

THURBER

Prep'd AN

Chkd. KF

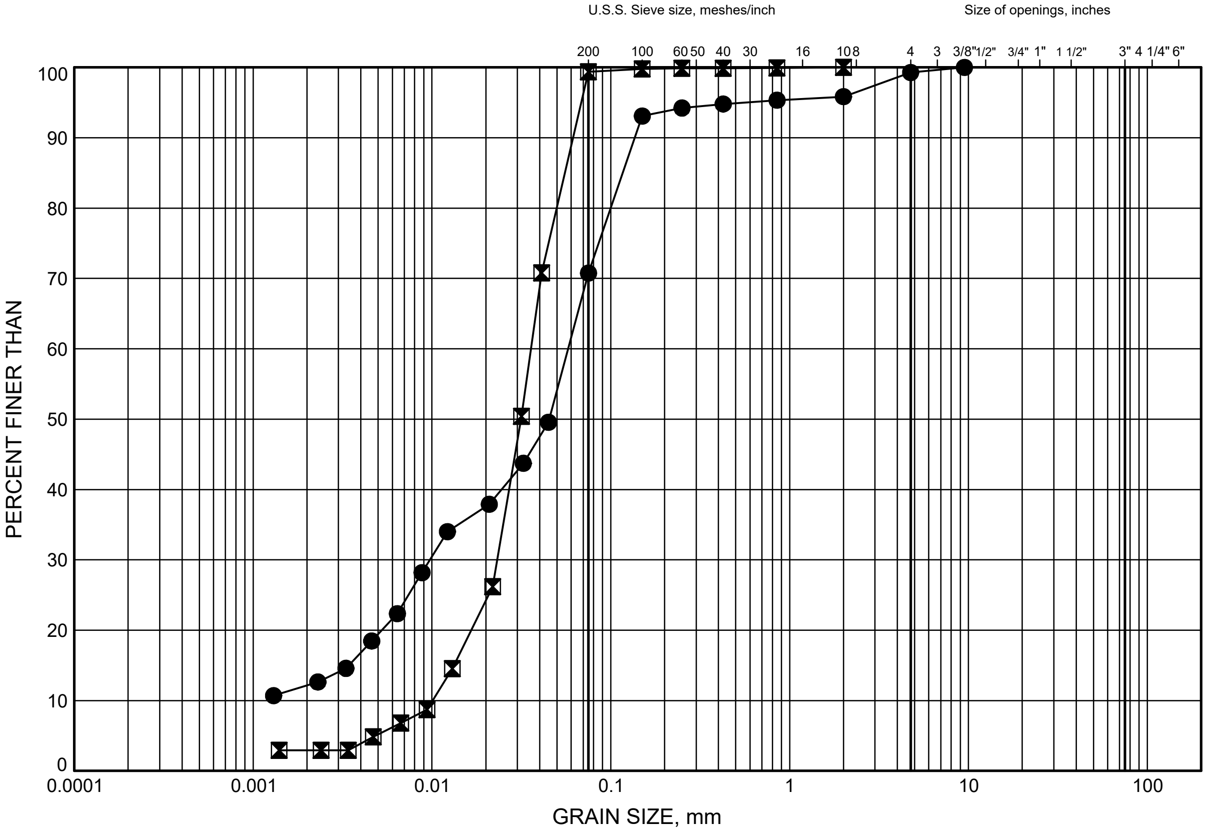
GRAIN SIZE DISTRIBUTION - THURBER TEL-27855.GPJ 11/11/20

Columbia Way EA

GRAIN SIZE DISTRIBUTION

FIGURE D4

SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	20-01	3.35	259.29
⧗	20-09	4.88	243.05

Date November 2020

Project 27855

THURBER

Prep'd AN

Chkd. KF

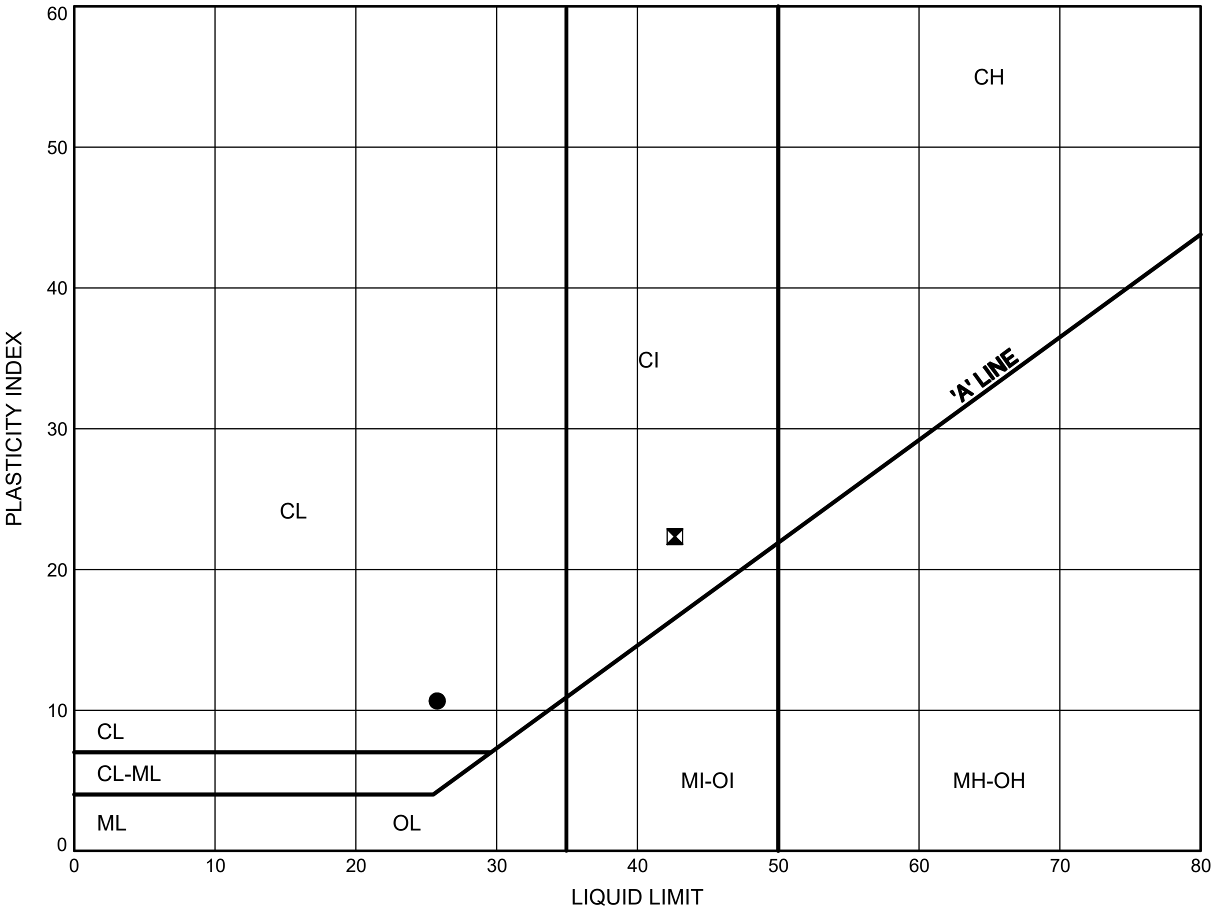
GRAIN SIZE DISTRIBUTION - THURBER TEL-27855.GPJ 11/11/20

Columbia Way EA

ATTERBERG LIMITS TEST RESULTS

FIGURE D5

CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	20-03	9.45	248.50
⧗	20-05	1.07	261.25

Date November 2020

Project 27855

Prep'd AN

Chkd. KF

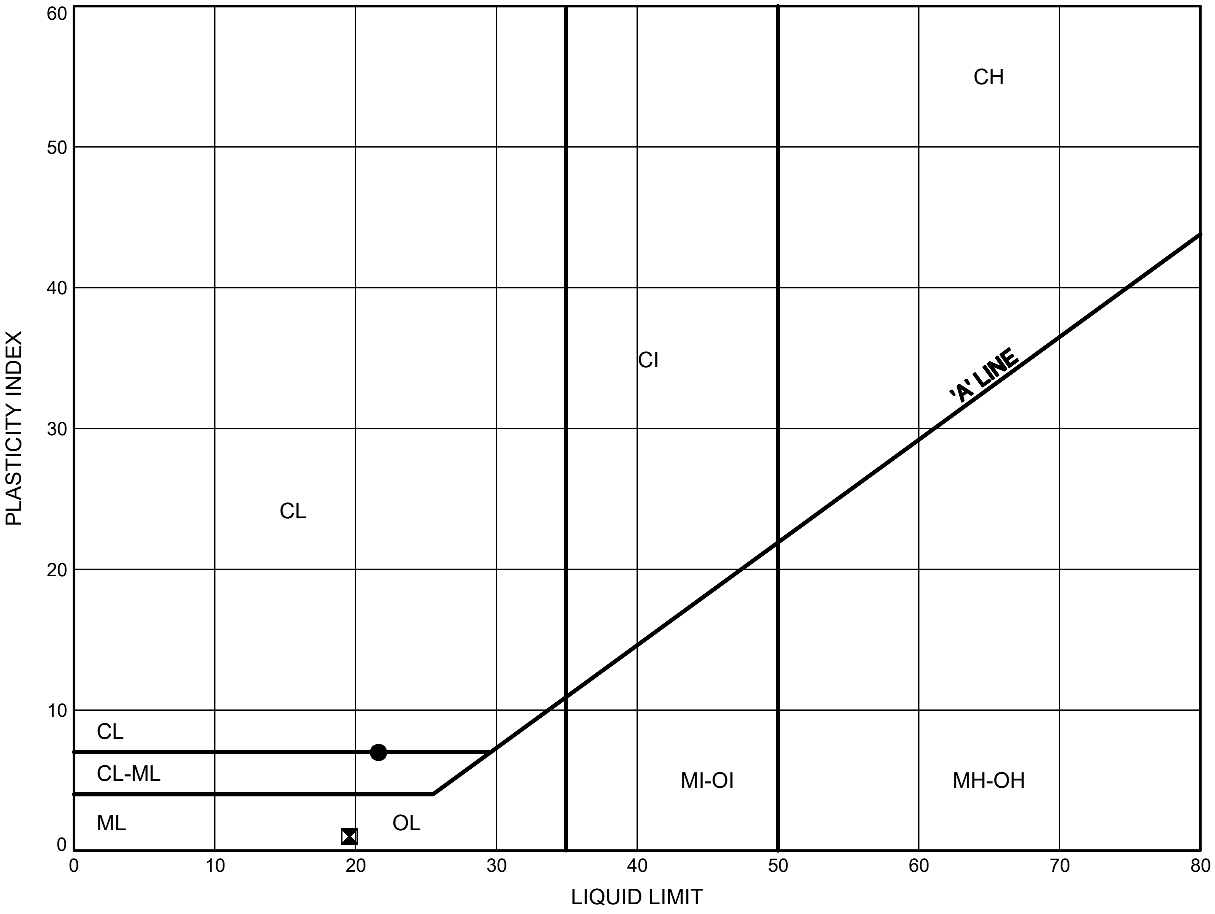
THURBALT TEL-27855.GPJ 11/11/20

Columbia Way EA

ATTERBERG LIMITS TEST RESULTS

FIGURE D6

SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	20-01	3.35	259.29
☒	20-09	4.88	243.05

Date November 2020

Project 27855

THURBER

Prep'd AN

Chkd. KF

THURBALT TEL-27855.GPJ 11/11/20

THURBER

Appendix E

Laboratory Certificates of Analysis – Soil Management

FINAL REPORT

CA14172-SEP20 R1

27855, Columbia Way EA

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	103 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada
Contact	Karel Furbacher
Telephone	289-455-7296
Facsimile	
Email	kfurbacher@thurber.ca
Project	27855, Columbia Way EA
Order Number	
Samples	Soil (5)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA14172-SEP20
Received	09/09/2020
Approved	09/15/2020
Report Number	CA14172-SEP20 R1
Date Reported	09/25/2020

COMMENTS

CCME Method Compliance: Analyses were conducted using analytical procedures that comply with the Reference Method for the CWS for Petroleum Hydrocarbons in Soil and have been validated for use at the SGS laboratory, Lakefield, ON site.

Quality Compliance: Instrument performance / calibration quality criteria were met and extraction and analysis limits for holding times were met.
nC6 and nC10 response factors within 30% of response factor for toluene: YES
nC10, nC16 and nC34 response factors within 10% of the average response for the three compounds: YES
C50 response factors within 70% of nC10 + nC16 + nC34 average: YES
Linearity is within 15%: YES

F4G - gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
The results for F4 and F4G are both reported and the greater of the two values is to be used in application to the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

Temperature of Sample upon Receipt: 6 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:1

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

PACKAGE: **REG153 - BTEX** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 2 - Residential/Parkland - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 8 - Residential/Parkland/Industrial - UNDEFINED

				Sample Number	11	12	14
				Sample Name	20-01 SS3	20-03 SS5	20-08 SS7
				Sample Matrix	Soil	Soil	Soil
				Sample Date	02/09/2020	02/09/2020	01/09/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
BTEX							
Benzene	µg/g	0.02	0.21	0.02	< 0.02	< 0.02	< 0.02
Ethylbenzene	µg/g	0.05	1.1	0.05	< 0.05	< 0.05	< 0.05
Toluene	µg/g	0.05	2.3	0.2	< 0.05	< 0.05	< 0.05
Xylene (total)	µg/g	0.05	3.1	0.05	< 0.05	< 0.05	< 0.05
m/p-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05
o-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05

PACKAGE: **REG153 - Hydrides** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 2 - Residential/Parkland - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 8 - Residential/Parkland/Industrial - UNDEFINED

				Sample Number	11	12	13	14	15
				Sample Name	20-01 SS3	20-03 SS5	20-05 SS5	20-08 SS7	20-09 SS5
				Sample Matrix	Soil	Soil	Soil	Soil	Soil
				Sample Date	02/09/2020	02/09/2020	03/09/2020	01/09/2020	01/09/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**	**Result**
Hydrides									
Antimony	µg/g	0.8	7.5	1.3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Arsenic	µg/g	0.5	18	18	1.9	3.7	3.2	1.8	2.0
Selenium	µg/g	0.7	2.4	1.5	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7

FINAL REPORT

CA14172-SEP20 R1

Client: Thurber Engineering Ltd.
Project: 27855, Columbia Way EA
Project Manager: Karel Furbacher
Samplers: Greg Stanhope

PACKAGE: **REG153 - Metals and Inorganics**
(SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 2 - Residential/Parkland - UNDEFINED
L2 = REG153 / SOIL / COARSE - TABLE 8 - Residential/Parkland/Industrial - UNDEFINED

Sample Number	11	12	13	14	15
Sample Name	20-01 SS3	20-03 SS5	20-05 SS5	20-08 SS7	20-09 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	02/09/2020	02/09/2020	03/09/2020	01/09/2020	01/09/2020

Metals and Inorganics

Parameter	Units	RL	L1	L2	Result	Result	Result	Result	Result
Moisture Content	%	0.1			21.6	17.3	13.7	20.8	14.8
Barium	µg/g	0.1	390	220	94	115	106	59	60
Beryllium	µg/g	0.02	4	2.5	0.82	0.96	0.71	0.21	0.35
Boron	µg/g	1	120	36	4	6	8	4	6
Cadmium	µg/g	0.02	1.2	1.2	0.15	0.13	0.08	0.06	0.06
Chromium	µg/g	0.5	160	70	25	26	22	8.1	14
Cobalt	µg/g	0.01	22	22	10	12	10	3.2	5.2
Copper	µg/g	0.1	140	92	12	26	27	6.3	13
Lead	µg/g	0.1	120	120	11	10	10	3.7	4.4
Molybdenum	µg/g	0.1	6.9	2	0.3	0.3	0.2	0.4	0.3
Nickel	µg/g	0.5	100	82	19	26	23	5.9	11
Silver	µg/g	0.05	20	0.5	0.07	< 0.05	< 0.05	< 0.05	< 0.05
Thallium	µg/g	0.02	1	1	0.14	0.15	0.15	0.04	0.09
Uranium	µg/g	0.002	23	2.5	0.66	0.46	0.52	0.29	1.1
Vanadium	µg/g	3	86	86	32	36	30	13	21
Zinc	µg/g	0.7	340	290	91	64	50	19	29
Water Soluble Boron	µg/g	0.5	1.5	1.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

PACKAGE: **REG153 - Other (ORP)** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 2 - Residential/Parkland - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 8 - Residential/Parkland/Industrial - UNDEFINED

				Sample Number	11	12	13	14	15
				Sample Name	20-01 SS3	20-03 SS5	20-05 SS5	20-08 SS7	20-09 SS5
				Sample Matrix	Soil	Soil	Soil	Soil	Soil
				Sample Date	02/09/2020	02/09/2020	03/09/2020	01/09/2020	01/09/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**	**Result**
Other (ORP)									
Mercury	ug/g	0.05	0.27	0.27	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sodium Adsorption Ratio	No unit	0.2	5	5	0.7	0.2	2.6	< 0.2	1.8
SAR Calcium	mg/L	0.09			89.7	32.9	45.8	65.8	46.3
SAR Magnesium	mg/L	0.02			14.0	4.0	13.4	8.7	15.1
SAR Sodium	mg/L	0.15			27.7	5.4	78.1	4.4	55.1
Conductivity	mS/cm	0.002	0.7	0.7	0.80	0.21	0.75	0.41	0.66
pH	pH Units	0.05			7.03	7.70	7.83	7.49	7.99
Chromium VI	µg/g	0.2	8	0.66	< 0.2	0.2	< 0.2	< 0.2	< 0.2
Free Cyanide	µg/g	0.05	0.051	0.051	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

PACKAGE: **REG153 - PHCs** (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 2 - Residential/Parkland - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 8 - Residential/Parkland/Industrial - UNDEFINED

				Sample Number	11	12	14
				Sample Name	20-01 SS3	20-03 SS5	20-08 SS7
				Sample Matrix	Soil	Soil	Soil
				Sample Date	02/09/2020	02/09/2020	01/09/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
PHCs							
F1 (C6-C10)	µg/g	10	55	25	< 10	< 10	< 10
F1-BTEX (C6-C10)	µg/g	10			< 10	< 10	< 10
F2 (C10-C16)	µg/g	10	98	10	< 10	< 10	< 10
F3 (C16-C34)	µg/g	50	300	240	< 50	< 50	< 50
F4 (C34-C50)	µg/g	50	2800	120	< 50	< 50	< 50
Chromatogram returned to baseline at nC50	Yes / No	-			YES	YES	YES

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	REG153 / SOIL / COARSE - TABLE 2 - Residential/Parkland - UNDEFINED L1	REG153 / SOIL / COARSE - TABLE 8 - Residential/Parkland/Industrial - UNDEFINED L2
20-01 SS3					
Conductivity	EPA 6010/SM 2510	mS/cm	0.80	0.7	0.7
20-05 SS5					
Conductivity	EPA 6010/SM 2510	mS/cm	0.75	0.7	0.7

QC SUMMARY

Conductivity

Method: EPA 6010/SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0179-SEP20	mS/cm	0.002	<0.002	2	10	99	90	110	NA		

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA5030-SEP20	µg/g	0.05	<0.05	ND	20	96	80	120	97	75	125

Hexavalent Chromium by SFA

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-[ENV]SKA-LAK-AN-012

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	SKA5042-SEP20	ug/g	0.2	<0.2	4	20	92	80	120	90	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/EPA 245 I Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EMS0054-SEP20	ug/g	0.05	<0.05	ND	20	102	80	120	90	70	130

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 I Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
SAR Calcium	ESG0041-SEP20	mg/L	0.09	<0.09	1	20	105	80	120	101	70	130
SAR Magnesium	ESG0041-SEP20	mg/L	0.02	<0.02	1	20	103	80	120	104	70	130
SAR Sodium	ESG0041-SEP20	mg/L	0.15	<0.15	1	20	101	80	120	101	70	130

FINAL REPORT

QC SUMMARY

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0054-SEP20	ug/g	0.05	<0.05	1	20	97	70	130	93	70	130
Arsenic	EMS0054-SEP20	ug/g	0.5	<0.5	0	20	101	70	130	98	70	130
Barium	EMS0054-SEP20	ug/g	0.1	<0.1	5	20	105	70	130	109	70	130
Beryllium	EMS0054-SEP20	ug/g	0.02	<0.02	1	20	95	70	130	112	70	130
Boron	EMS0054-SEP20	ug/g	1	<1	5	20	105	70	130	105	70	130
Cadmium	EMS0054-SEP20	ug/g	0.02	<0.02	4	20	93	70	130	101	70	130
Cobalt	EMS0054-SEP20	ug/g	0.01	<0.01	0	20	96	70	130	104	70	130
Chromium	EMS0054-SEP20	ug/g	0.5	<0.5	0	20	97	70	130	110	70	130
Copper	EMS0054-SEP20	ug/g	0.1	<0.1	8	20	100	70	130	98	70	130
Molybdenum	EMS0054-SEP20	ug/g	0.1	<0.1	10	20	99	70	130	112	70	130
Nickel	EMS0054-SEP20	ug/g	0.5	<0.5	1	20	94	70	130	102	70	130
Lead	EMS0054-SEP20	ug/g	0.1	<0.1	5	20	99	70	130	98	70	130
Antimony	EMS0054-SEP20	ug/g	0.8	<0.8	ND	20	97	70	130	100	70	130
Selenium	EMS0054-SEP20	ug/g	0.7	<0.7	ND	20	103	70	130	104	70	130
Thallium	EMS0054-SEP20	ug/g	0.02	<0.02	4	20	101	70	130	102	70	130
Uranium	EMS0054-SEP20	ug/g	0.002	<0.002	1	20	97	70	130	84	70	130
Vanadium	EMS0054-SEP20	ug/g	3	<3	1	20	96	70	130	111	70	130
Zinc	EMS0054-SEP20	ug/g	0.7	<0.7	1	20	99	70	130	103	70	130

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F1 (C6-C10)	GCM0183-SEP20	µg/g	10	<10	ND	30	117	80	120	104	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F2 (C10-C16)	GCM0186-SEP20	µg/g	10	<10	ND	30	115	80	120	116	60	140
F3 (C16-C34)	GCM0186-SEP20	µg/g	50	<50	ND	30	115	80	120	116	60	140
F4 (C34-C50)	GCM0186-SEP20	µg/g	50	<50	ND	30	115	80	120	116	60	140

FINAL REPORT

QC SUMMARY

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	ARD0028-SEP20	pH Units	0.05		0	20	100	80	120			

Volatile Organics

Method: EPA 5035A/5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Benzene	GCM0183-SEP20	µg/g	0.02	<0.02	ND	50	115	60	130	98	50	140
Ethylbenzene	GCM0183-SEP20	µg/g	0.05	<0.05	ND	50	104	60	130	94	50	140
m/p-xylene	GCM0183-SEP20	µg/g	0.05	<0.05	ND	50	112	60	130	101	50	140
o-xylene	GCM0183-SEP20	µg/g	0.05	<0.05	ND	50	103	60	130	94	50	140
Toluene	GCM0183-SEP20	µg/g	0.05	<0.05	ND	50	109	60	130	96	50	140

QC SUMMARY

Water Soluble Boron

Method: O.Reg. 153/04 | Internal ref.: ME-CA-[ENV] SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Water Soluble Boron	ESG0032-SEP20	µg/g	0.5	<0.5	ND	20	102	80	120	114	70	130

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act” published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS Environment, Health & Safety

Request for Laboratory Services and CHAIN OF CUSTODY

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 1

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Ahmed Al-Mandalawi

Received Date (mm/dd/yy): 09/09/2020

Received Time: 11:06

Received By (signature):

Custody Seal Present: ☒

Custody Seal Intact: ☒

Cooling Agent Present: ☒ ICE

Temperature Upon Receipt (°C) 6°, 6°, 6°

LAB LIMS #: CA-14172-Sep20

REPORT INFORMATION

Company: Thurber Engineering Ltd.

Contact: Karel Furbacher

Address: 103-2010 Winston Park Drive
Oakville, Ontario

Phone: 289-455-7296

Email: kfurbacher@thurber.ca

Email:

INVOICE INFORMATION

☑ (same as Report Information)

Company:

Contact:

Address:

Phone:

Email:

PROJECT INFORMATION

Quotation #:

P.O. #:

Project #: 27855

Site Location/ID: Columbia Way EA

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:

Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04:

☑ Table 1 RPI/ICC ☐ R/P/I

☐ Table 2 ☐ I/C/C

☐ Table 3 ☐ A/O

☑ Table 2.1 RPI O. Reg. 406/19

Soil Texture:

☑ Coarse

☐ Medium

☐ Fine

Other Regulations:

☐ Reg 347/558 (3 Day min TAT)

☐ PWQO ☐ MMER

☐ CCME ☐ Other:

☐ MISA

Sewer By-Law:

☐ Sanitary

☐ Storm

Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☑ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	PHC F1-F4 ☑ VOC ☐ BTEX ☑ BTEX/F1 ☐ F2-F4 ☐	VOC ☐ BTEX ☐ THM ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	Corrosivity/Resistivity					COMMENTS:
1	20-01 SS3	9/2/20	9:20 A.M.	4	SOIL		☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	20-03 SS5	9/2/20	1:30 P.M.	4	SOIL		☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
3	20-05 SS5	9/3/20	2:45 P.M.	2	SOIL		☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
4	20-08 SS7	9/1/20	1:00 P.M.	4	SOIL		☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
5	20-09 SS5	9/1/20	10:00 A.M.	2	SOIL		☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Observations/Comments/Special Instructions

Sampled By (NAME): Greg Stanhope

Signature:

Date: 09/09/20 (mm/dd/yy)

Pink Copy - Client

Relinquished by (NAME): Karel Furbacher

Signature: Karel

Digitally signed by Karel
Date: 2020.09.09 11:01:08 -04'00'

Date: 09/09/20 (mm/dd/yy)

Yellow & White Copy - SGS

Revision # 1.1

Date of Issue 04 April, 2018

FINAL REPORT

CA14172-SEP20 R1

27855, Columbia Way EA

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

CA14172-SEP20 R1

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	103 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Karel Furbacher	Telephone	705-652-2143
Telephone	289-455-7296	Facsimile	705-652-6365
Facsimile		Email	brad.moore@sgs.com
Email	kfurbacher@thurber.ca	SGS Reference	CA14172-SEP20
Project	27855, Columbia Way EA	Received	09/09/2020
Order Number		Approved	09/15/2020
Samples	Soil (5)	Report Number	CA14172-SEP20 R1
		Date Reported	12/03/2020

COMMENTS

CCME Method Compliance: Analyses were conducted using analytical procedures that comply with the Reference Method for the CWS for Petroleum Hydrocarbons in Soil and have been validated for use at the SGS laboratory, Lakefield, ON site.

Quality Compliance: Instrument performance / calibration quality criteria were met and extraction and analysis limits for holding times were met.
nC6 and nC10 response factors within 30% of response factor for toluene: YES
nC10, nC16 and nC34 response factors within 10% of the average response for the three compounds: YES
C50 response factors within 70% of nC10 + nC16 + nC34 average: YES
Linearity is within 15%: YES

F4G - gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
The results for F4 and F4G are both reported and the greater of the two values is to be used in application to the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

Temperature of Sample upon Receipt: 6 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:1

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

PACKAGE: **REG406 - BTEX** (SOIL)

L1 = REG406 / SOIL / - - Appendix 1 Table 1 - Residential/Parkland/Institutional/Industrial/Commercial/Community - UNDEFINED

L2 = REG406 / SOIL / - - Appendix 1 Table 2.1 - Residential/Parkland/Industrial - UNDEFINED

				Sample Number	11	12	14
				Sample Name	20-01 SS3	20-03 SS5	20-08 SS7
				Sample Matrix	Soil	Soil	Soil
				Sample Date	02/09/2020	02/09/2020	01/09/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
BTEX							
Benzene	µg/g	0.02	0.02	0.02	< 0.02	< 0.02	< 0.02
Ethylbenzene	µg/g	0.05	0.05	0.05	< 0.05	< 0.05	< 0.05
Toluene	µg/g	0.05	0.2	0.2	< 0.05	< 0.05	< 0.05
Xylene (total)	µg/g	0.05	0.05	0.091	< 0.05	< 0.05	< 0.05
m/p-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05
o-xylene	µg/g	0.05			< 0.05	< 0.05	< 0.05

PACKAGE: **REG406 - Hydrides** (SOIL)

L1 = REG406 / SOIL / - - Appendix 1 Table 1 - Residential/Parkland/Institutional/Industrial/Commercial/Community - UNDEFINED

L2 = REG406 / SOIL / - - Appendix 1 Table 2.1 - Residential/Parkland/Industrial - UNDEFINED

				Sample Number	11	12	13	14	15
				Sample Name	20-01 SS3	20-03 SS5	20-05 SS5	20-08 SS7	20-09 SS5
				Sample Matrix	Soil	Soil	Soil	Soil	Soil
				Sample Date	02/09/2020	02/09/2020	03/09/2020	01/09/2020	01/09/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**	**Result**
Hydrides									
Antimony	µg/g	0.8	1.3	7.5	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Arsenic	µg/g	0.5	18	18	1.9	3.7	3.2	1.8	2.0
Selenium	µg/g	0.7	1.5	2.4	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7

PACKAGE: **REG406 - Metals and Inorganics**
(SOIL)

L1 = REG406 / SOIL / - - Appendix 1 Table 1 - Residential/Parkland/Institutional/Industrial/Commercial/Community - UNDEFINED

L2 = REG406 / SOIL / - - Appendix 1 Table 2.1 - Residential/Parkland/Industrial - UNDEFINED

Sample Number	11	12	13	14	15
Sample Name	20-01 SS3	20-03 SS5	20-05 SS5	20-08 SS7	20-09 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	02/09/2020	02/09/2020	03/09/2020	01/09/2020	01/09/2020

Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**	**Result**
Metals and Inorganics									
Moisture Content	%	0.1			21.6	17.3	13.7	20.8	14.8
Barium	µg/g	0.1	220	390	94	115	106	59	60
Beryllium	µg/g	0.02	2.5	4	0.82	0.96	0.71	0.21	0.35
Boron	µg/g	1	36	120	4	6	8	4	6
Cadmium	µg/g	0.02	1.2	1.2	0.15	0.13	0.08	0.06	0.06
Chromium	µg/g	0.5	70	160	25	26	22	8.1	14
Cobalt	µg/g	0.01	21	22	10	12	10	3.2	5.2
Copper	µg/g	0.1	92	140	12	26	27	6.3	13
Lead	µg/g	0.1	120	120	11	10	10	3.7	4.4
Molybdenum	µg/g	0.1	2	6.9	0.3	0.3	0.2	0.4	0.3
Nickel	µg/g	0.5	82	100	19	26	23	5.9	11
Silver	µg/g	0.05	0.5	20	0.07	< 0.05	< 0.05	< 0.05	< 0.05
Thallium	µg/g	0.02	1	1	0.14	0.15	0.15	0.04	0.09
Uranium	µg/g	0.002	2.5	23	0.66	0.46	0.52	0.29	1.1
Vanadium	µg/g	3	86	86	32	36	30	13	21
Zinc	µg/g	0.7	290	340	91	64	50	19	29
Water Soluble Boron	µg/g	0.5		1.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

FINAL REPORT

Client: Thurber Engineering Ltd.
Project: 27855, Columbia Way EA
Project Manager: Karel Furbacher
Samplers: Greg Stanhope

PACKAGE: **REG406 - Other (ORP)** (SOIL)

L1 = REG406 / SOIL / - - Appendix 1 Table 1 - Residential/Parkland/Institutional/Industrial/Commercial/Community - UNDEFINED

L2 = REG406 / SOIL / - - Appendix 1 Table 2.1 - Residential/Parkland/Industrial - UNDEFINED

				Sample Number	11	12	13	14	15
				Sample Name	20-01 SS3	20-03 SS5	20-05 SS5	20-08 SS7	20-09 SS5
				Sample Matrix	Soil	Soil	Soil	Soil	Soil
				Sample Date	02/09/2020	02/09/2020	03/09/2020	01/09/2020	01/09/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**	**Result**
Other (ORP)									
Mercury	ug/g	0.05	0.27	0.27	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sodium Adsorption Ratio	No unit	0.2	2.4	5	0.7	0.2	2.6	< 0.2	1.8
SAR Calcium	mg/L	0.09			89.7	32.9	45.8	65.8	46.3
SAR Magnesium	mg/L	0.02			14.0	4.0	13.4	8.7	15.1
SAR Sodium	mg/L	0.15			27.7	5.4	78.1	4.4	55.1
Conductivity	mS/cm	0.002	0.57	0.7	0.80	0.21	0.75	0.41	0.66
pH	pH Units	0.05			7.03	7.70	7.83	7.49	7.99
Chromium VI	μg/g	0.2	0.66	8	< 0.2	0.2	< 0.2	< 0.2	< 0.2
Free Cyanide	μg/g	0.05	0.051	0.051	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

PACKAGE: **REG406 - PHCs** (SOIL)

L1 = REG406 / SOIL / - - Appendix 1 Table 1 - Residential/Parkland/Institutional/Industrial/Commercial/Community - UNDEFINED

L2 = REG406 / SOIL / - - Appendix 1 Table 2.1 - Residential/Parkland/Industrial - UNDEFINED

				Sample Number	11	12	14
				Sample Name	20-01 SS3	20-03 SS5	20-08 SS7
				Sample Matrix	Soil	Soil	Soil
				Sample Date	02/09/2020	02/09/2020	01/09/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
PHCs							
F1 (C6-C10)	µg/g	10	25	25	< 10	< 10	< 10
F1-BTEX (C6-C10)	µg/g	10			< 10	< 10	< 10
F2 (C10-C16)	µg/g	10	10	10	< 10	< 10	< 10
F3 (C16-C34)	µg/g	50	240	240	< 50	< 50	< 50
F4 (C34-C50)	µg/g	50	120	2800	< 50	< 50	< 50
Chromatogram returned to baseline at nC50	Yes / No	-			YES	YES	YES

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	REG406 / SOIL / - - Appendix 1 Table 1 - Residential/Parkland/Institutional/Industrial/Commercial/Community - UNDEFINED L1	REG406 / SOIL / - - Appendix 1 Table 2.1 - Residential/Parkland/Industrial - UNDEFINED L2
20-01 SS3					
Conductivity	EPA 6010/SM 2510	mS/cm	0.80	0.57	0.7
20-05 SS5					
Conductivity	EPA 6010/SM 2510	mS/cm	0.75	0.57	0.7
Sodium Adsorption Ratio	MOE 4696e01/EPA 6010	No unit	2.6	2.4	
20-09 SS5					
Conductivity	EPA 6010/SM 2510	mS/cm	0.66	0.57	

QC SUMMARY

Conductivity

Method: EPA 6010/SM 2510 l Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0179-SEP20	mS/cm	0.002	<0.002	2	10	99	90	110	NA		

Cyanide by SFA

Method: SM 4500 l Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA5030-SEP20	µg/g	0.05	<0.05	ND	20	96	80	120	97	75	125

Hexavalent Chromium by SFA

Method: EPA218.6/EPA3060A l Internal ref.: ME-CA-[ENV]SKA-LAK-AN-012

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	SKA5042-SEP20	ug/g	0.2	<0.2	4	20	92	80	120	90	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/EPA 245 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EMS0054-SEP20	ug/g	0.05	<0.05	ND	20	102	80	120	90	70	130

Metals in aqueous samples - ICP-OES

Method: MOE 4696e01/EPA 6010 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
SAR Calcium	ESG0041-SEP20	mg/L	0.09	<0.09	1	20	105	80	120	101	70	130
SAR Magnesium	ESG0041-SEP20	mg/L	0.02	<0.02	1	20	103	80	120	104	70	130
SAR Sodium	ESG0041-SEP20	mg/L	0.15	<0.15	1	20	101	80	120	101	70	130

QC SUMMARY

Metals in Soil - Aqua-regia/ICP-MS

Method: EPA 3050/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0054-SEP20	ug/g	0.05	<0.05	1	20	97	70	130	93	70	130
Arsenic	EMS0054-SEP20	ug/g	0.5	<0.5	0	20	101	70	130	98	70	130
Barium	EMS0054-SEP20	ug/g	0.1	<0.1	5	20	105	70	130	109	70	130
Beryllium	EMS0054-SEP20	ug/g	0.02	<0.02	1	20	95	70	130	112	70	130
Boron	EMS0054-SEP20	ug/g	1	<1	5	20	105	70	130	105	70	130
Cadmium	EMS0054-SEP20	ug/g	0.02	<0.02	4	20	93	70	130	101	70	130
Cobalt	EMS0054-SEP20	ug/g	0.01	<0.01	0	20	96	70	130	104	70	130
Chromium	EMS0054-SEP20	ug/g	0.5	<0.5	0	20	97	70	130	110	70	130
Copper	EMS0054-SEP20	ug/g	0.1	<0.1	8	20	100	70	130	98	70	130
Molybdenum	EMS0054-SEP20	ug/g	0.1	<0.1	10	20	99	70	130	112	70	130
Nickel	EMS0054-SEP20	ug/g	0.5	<0.5	1	20	94	70	130	102	70	130
Lead	EMS0054-SEP20	ug/g	0.1	<0.1	5	20	99	70	130	98	70	130
Antimony	EMS0054-SEP20	ug/g	0.8	<0.8	ND	20	97	70	130	100	70	130
Selenium	EMS0054-SEP20	ug/g	0.7	<0.7	ND	20	103	70	130	104	70	130
Thallium	EMS0054-SEP20	ug/g	0.02	<0.02	4	20	101	70	130	102	70	130
Uranium	EMS0054-SEP20	ug/g	0.002	<0.002	1	20	97	70	130	84	70	130
Vanadium	EMS0054-SEP20	ug/g	3	<3	1	20	96	70	130	111	70	130
Zinc	EMS0054-SEP20	ug/g	0.7	<0.7	1	20	99	70	130	103	70	130

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F1 (C6-C10)	GCM0183-SEP20	µg/g	10	<10	ND	30	117	80	120	104	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F2 (C10-C16)	GCM0186-SEP20	µg/g	10	<10	ND	30	115	80	120	116	60	140
F3 (C16-C34)	GCM0186-SEP20	µg/g	50	<50	ND	30	115	80	120	116	60	140
F4 (C34-C50)	GCM0186-SEP20	µg/g	50	<50	ND	30	115	80	120	116	60	140

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	**QC batch Reference**	**Units**	**RL**	**Method Blank**	**Duplicate**		**LCS/Spike Blank**			**Matrix Spike / Ref.**		
					RPD	**AC (%)**	**Spike Recovery (%)**	**Recovery Limits (%)**		**Spike Recovery (%)**	**Recovery Limits (%)**	
								Low	**High**		**Low**	**High**
pH	ARD0028-SEP20	pH Units	0.05		0	20	100	80	120			

Volatile Organics

Method: EPA 5035A/5030B/8260C I Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	**QC batch Reference**	**Units**	**RL**	**Method Blank**	**Duplicate**		**LCS/Spike Blank**			**Matrix Spike / Ref.**		
					RPD	**AC (%)**	**Spike Recovery (%)**	**Recovery Limits (%)**		**Spike Recovery (%)**	**Recovery Limits (%)**	
								Low	**High**		**Low**	**High**
Benzene	GCM0183-SEP20	µg/g	0.02	<0.02	ND	50	115	60	130	98	50	140
Ethylbenzene	GCM0183-SEP20	µg/g	0.05	<0.05	ND	50	104	60	130	94	50	140
m/p-xylene	GCM0183-SEP20	µg/g	0.05	<0.05	ND	50	112	60	130	101	50	140
o-xylene	GCM0183-SEP20	µg/g	0.05	<0.05	ND	50	103	60	130	94	50	140
Toluene	GCM0183-SEP20	µg/g	0.05	<0.05	ND	50	109	60	130	96	50	140

QC SUMMARY

Water Soluble Boron

Method: O.Reg. 15 3/04 | Internal ref.: ME-CA-[ENV] SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Water Soluble Boron	ESG0032-SEP20	μg/g	0.5	<0.5	ND	20	102	80	120	114	70	130

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act” published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS Environment, Health & Safety

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Request for Laboratory Services and CHAIN OF CUSTODY

No: 1

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Ahmed Al-Mandalawi

Received Date (mm/dd/yy): 09/09/2020

Received Time: 11:06

Received By (signature):

Custody Seal Present: ☒

Custody Seal Intact: ☒

Cooling Agent Present: ☒ ICE

Temperature Upon Receipt (°C) 6°, 6°, 6°

LAB LIMS #: CA-14172-Sep20

REPORT INFORMATION

Company: Thurber Engineering Ltd.

Contact: Karel Furbacher

Address: 103-2010 Winston Park Drive
Oakville, Ontario

Phone: 289-455-7296

Email: kfurbacher@thurber.ca

Email:

INVOICE INFORMATION

☑ (same as Report Information)

Company:

Contact:

Address:

Phone:

Email:

PROJECT INFORMATION

Quotation #:

P.O. #:

Project #: 27855

Site Location/ID: Columbia Way EA

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:

Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04:

☑ Table 1 RPI/ICC ☐ R/P/I

☐ Table 2 ☐ I/C/C

☐ Table 3 ☐ A/O

☑ Table 2.1 RPI O. Reg. 406/19

Soil Texture:

☑ Coarse

☐ Medium

☐ Fine

Other Regulations:

☐ Reg 347/558 (3 Day min TAT)

☐ PWQO ☐ MMER

☐ CCME ☐ Other:

☐ MISA

Sewer By-Law:

☐ Sanitary

☐ Storm

Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☑ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	PHC F1-F4 ☑ VOC ☐ BTEX ☑ BTEX/F1 ☐ F2-F4 ☐	VOC ☐ BTEX ☐ THM ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	Corrosivity/Resistivity						COMMENTS:
1	20-01 SS3	9/2/20	9:20 A.M.	4	SOIL		☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
2	20-03 SS5	9/2/20	1:30 P.M.	4	SOIL		☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
3	20-05 SS5	9/3/20	2:45 P.M.	2	SOIL		☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
4	20-08 SS7	9/1/20	1:00 P.M.	4	SOIL		☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
5	20-09 SS5	9/1/20	10:00 A.M.	2	SOIL		☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		

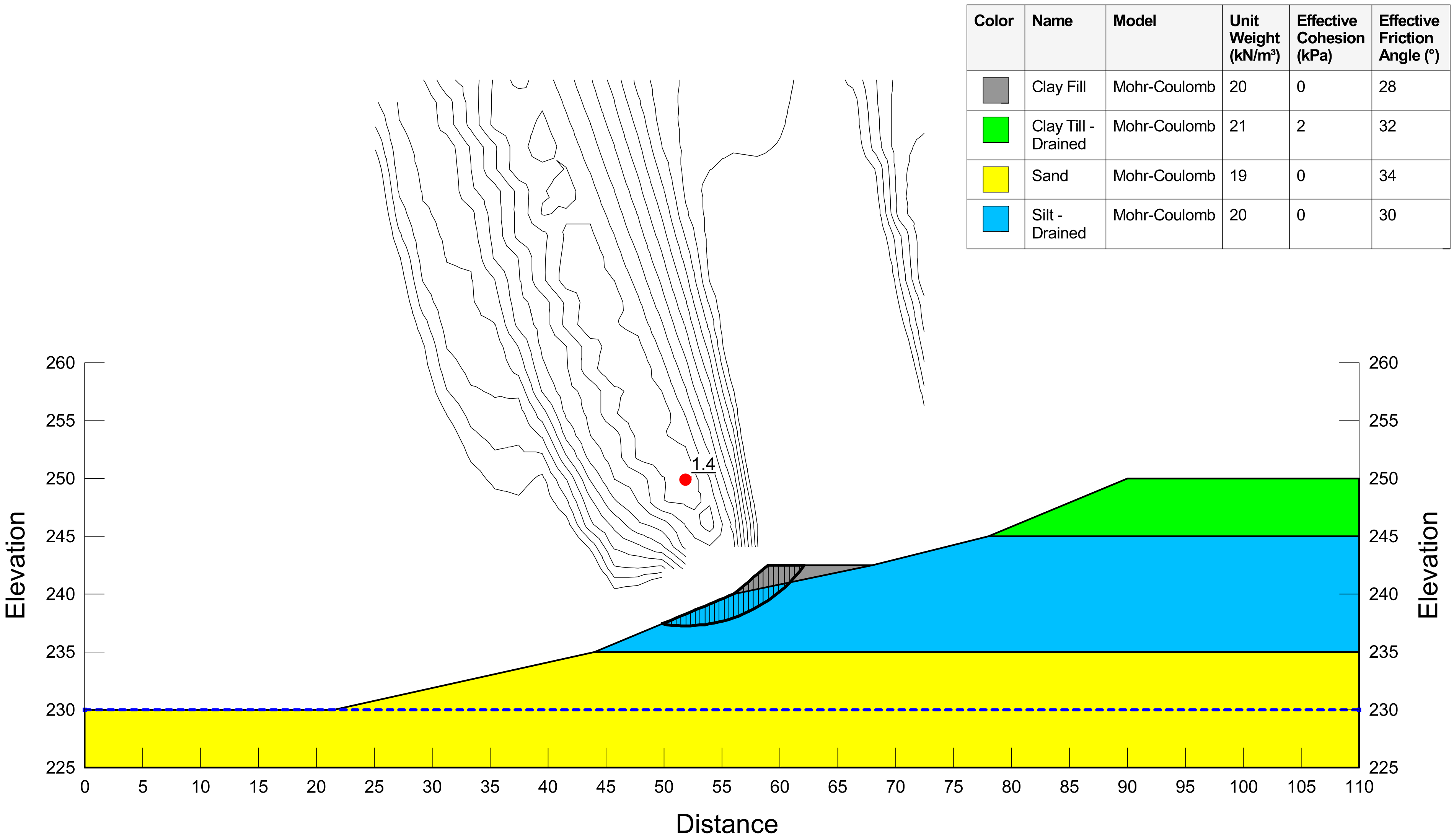
Observations/Comments/Special Instructions

Sampled By (NAME):	Greg Stanhope	Signature:		Date: 09/09/20	(mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME):	Karel Furbacher	Signature:	Karel Digitally signed by Karel Date: 2020.09.09 11:01:08 -04'00'	Date: 09/09/20	(mm/dd/yy)	Yellow & White Copy - SGS

Revision # 1.1
Date of Issue 04 April, 2018

Appendix F

Slope Stability Analysis



Color	Name	Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
▨	Clay Fill	Mohr-Coulomb	20	0	28
🟩	Clay Till - Drained	Mohr-Coulomb	21	2	32
🟨	Sand	Mohr-Coulomb	19	0	34
🟦	Silt - Drained	Mohr-Coulomb	20	0	30

THURBER

Project
Columbia Way EA

Analysis
Static - Drained (6)

Seismic Coefficient
H: 0g, V: 0g

Last Run
2020-12-01, 02:34:38 PM

Scale
1:500

Additional Details
Name: Slope East of Forest Gate Avenue
Comments:
Method: Morgenstern-Price, Half-Sine
Minimum Slip Surface Depth: 3 m
Entry: (62.100295, 242.5) m, Exit: (49.828484, 237.42853) m
Center: (51.86708, 249.87884) m, Radius: 12.6161 m

Figure F1

H:\20000-29999\27000-27999\27855 Columbia Way EA\Analysis\Slope Stability\27855 Slope Stability 2020-11-19.gsz

Tool Version: 11.0.1.21429